UNIVERSITY OF PENNSYLVANIA

---

# THE DEVELOPMENT OF HORSE-POWER EQUIPMENT IN THE UNITED STATES

CARROLL ROOP DAUGHERTY

A THESIS

IN ECONOMICS

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

PHILADELPHIA
1927

# THE DEVELOPMENT OF HORSE-POWER EQUIPMENT IN THE UNITED STATES

A THESIS

IN ECONOMICS

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL OF THE UNIVERSITY OF PENNSYLVANIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

CARROLL ROOP DAUGHERTY

Reprint from Water-Supply Paper 579, published by the United States Geological Survey, Government Printing Office
Washington, D. C.

PHILADELPHIA
1927

R. UNIV.
BIBLIOTHEEK
LEIDEN

# THE DEVELOPMENT OF HORSEPOWER EQUIPMENT IN THE UNITED STATES

BY

CARROLL ROOP DAUGHERTY

# CONTENTS


| | Page |
|---|---|
| Prefatory note | 11 |
| Introduction | 11 |
| Sources and accuracy of the data | 15 |
| Development of prime movers | 23 |
| Certain findings of the study | 30 |
| Some uses for the power index | 36 |
| Bibliography | 43 |
| Tables | 45 |


# ILLUSTRATIONS


| | | Page |
|---|---|---|
| PLATE 1. | Horsepower of prime movers installed and utilized in different activities, 1849–1923, by types of prime movers | 84 |
| FIGURE 1. | Total horsepower of prime movers in the United States, 1849–1923 | 79 |
| 2. | Horsepower of prime movers installed in different activities, 1849–1923 | 80 |
| 3. | Horsepower utilized in each field of activity, 1849–1923 | 81 |
| 4. | Index numbers of horsepower of prime movers, 1849–1923, by types of prime movers | 82 |
| 5. | Percentages of horsepower of prime movers, 1849–1923, by different types of prime movers | 83 |
| 6. | Horsepower of prime movers, 1849–1923, by special groups | 84 |
| 7. | Horsepower of prime movers, 1849–1923, by special groups | 84 |
| 8. | Horsepower of prime movers, population, and wage earners in United States, 1849–1923 | 85 |
| 9. | Horsepower of prime movers, population, and wage earners in United States, 1849–1923 | 86 |
| 10. | Horsepower of prime movers, population, and wage earners in United States, 1849–1923 | 87 |
| 11. | Horsepower of prime movers installed per inhabitant and per wage earner and utilized per wage earner in different activities and groups, 1849–1923 | 88 |
| 12. | Total horsepower of prime movers, 1923 | 89 |
| 13. | Total horsepower of prime movers, 1919 | 90 |
| 14. | Total horsepower of prime movers, 1909 | 91 |
| 15. | Total horsepower of prime movers, 1899 | 92 |
| 16. | Total horsepower of prime movers, 1889 | 93 |
| 17. | Total horsepower of prime movers, 1879 | 94 |
| 18. | Total horsepower of prime movers, 1869 | 95 |
| 19. | Horsepower of prime movers in motor-driven vehicles, 1923 | 96 |
| 20. | Horsepower of prime movers per square mile, 1923, by States and geographic divisions | 97 |

Page

FIGURE 21. Horsepower of prime movers utilized in manufactures, 1923 98
22. Percentage of total horsepower of prime movers utilized in manufactures, 1923, by types of prime movers 99
23. Chief types of prime movers utilized in manufactures, 1923 100
24. Horsepower of steam engines and turbines utilized in manufactures, 1923 101
25. Horsepower of internal-combustion engines installed in manufactures, 1923 102
26. Horsepower of water wheels installed in manufactures, 1923 103
27. Horsepower per square mile of prime movers utilized in manufactures, 1923 104
28. Horsepower of prime movers utilized in mines and quarries, 1919 105
29. Horsepower of prime movers utilized in agriculture, 1923 106
30. Horsepower per square mile of prime movers utilized in agriculture, 1923 107
31. Horsepower of prime movers installed in irrigation and drainage, 1923 108
32. Horsepower of prime movers in central electric stations and electric railroads plus horsepower of electric motors driven by electricity generated in manufactures, 1923, and in mines and quarries, 1919 109
33. Horsepower of prime movers in ships, 1923 110
34. Horsepower of prime movers, number of wage earners, and volume of production, 1889–1919, by special groups 111
35. Total horsepower of prime movers and acreage of improved land, 1849–1923 112

## TABLES

Page

1. Total horsepower of prime movers in the United States, 1849–1923 45
2. Horsepower of prime movers installed in different activities, 1849–1923 45
3. Horsepower utilized in each field of activity, 1849–1923 47
4. Horsepower of prime movers, 1849–1923, by types of prime movers 48
5. Horsepower of prime movers utilized, 1849–1923, by types of prime movers and fields of activity 49
6. Horsepower of prime movers, 1849–1923, by special groups 52
7. Population and wage earners in the United States, 1849–1923 53
8. Horsepower of prime movers installed per inhabitant and per wage earner and utilized per wage earner in different activities and groups, 1849–1923 54
9. Total horsepower, in thousands, of prime movers, 1869–1923, by States and geographic divisions 55
10. Horsepower of prime movers per square mile, 1923, by States and geographic divisions 57
11. Horsepower, in thousands, of prime movers utilized by manufactures, 1869–1923, by States and geographic divisions 58
12. Percentage of total horsepower of prime movers utilized in manufactures, 1923, by types of prime movers 60
13. Horsepower, in thousands, of prime movers utilized in mines and quarries, 1899–1923, by States and geographic divisions 61

Page

14. Horsepower, in thousands, of prime movers utilized in agriculture, 1869–1923, by States and geographic divisions ..... 62
15. Horsepower, in thousands, of prime movers installed in irrigation and drainage, 1909–1923, by States and geographic divisions ..... 64
16. Horsepower, in thousands, of prime movers in electric central stations, 1899–1923, by States and geographic divisions ..... 65
17. Horsepower, in thousands, of prime movers in electric railroads, 1899–1923, by States and geographic divisions ..... 66
18. Horsepower, in thousands, of prime movers in central electric stations and electric railroads plus horsepower of electric motors driven by electricity generated in manufactures and in mines and quarries, 1899–1923, by States and geographic divisions ..... 67
19. Horsepower, in thousands, of prime movers installed in ships, 1889–1923, by States and geographic divisions ..... 68
20. Horsepower, in thousands, of prime movers in motor-driven vehicles, 1919 and 1923, by States and geographic divisions ..... 69
21. Index numbers of horsepower of prime movers, number of wage earners, and volume of production, 1889–1919, by special groups ..... 70
22. Index numbers of total horsepower of prime movers and acreage of improved land, 1849–1923 ..... 70
23. Horsepower, in thousands, of prime movers utilized in manufactures, 1849–1923 ..... 71
24. Horsepower, in thousands, of prime movers utilized in mines and quarries, 1849–1923 ..... 71
25. Horsepower, in thousands, of prime movers utilized in agriculture, 1849–1923 ..... 71
26. Approximate number, in thousands, of draft animals in the United States, 1849–1923 ..... 72
27. Horsepower, in thousands, of prime movers in central stations and electric railroads, 1889–1923 ..... 72
28. Horsepower, in thousands, of prime movers utilized in irrigation and drainage, 1879–1923 ..... 72
29. Horsepower of locomotives of steam railroads, 1849–1923 ..... 73
30. Horsepower, in thousands, of prime movers in ships, 1849–1923 ..... 73
31. Horsepower, in thousands, of prime movers of motor-driven vehicles (automobiles), 1899–1923 ..... 74
32. Number of automobiles registered, 1899–1923 ..... 74
33. Average horsepower used in determining total horsepower of automobile engines in 1909, 1919, and 1923 ..... 75
34. Number of wage earners and horsepower of prime movers in certain industrial establishments not included in census totals for manufactures, 1909 and 1919 ..... 75
35. Horsepower of prime movers of municipal water-supply plants of certain cities for 1926 ..... 75
36. Horsepower of prime movers of aircraft of the Army and Navy and of the ships of the Navy ..... 75
37. Prime movers utilized in manufactures in the United States in 1923, by geographic divisions and States ..... 76
38. Distribution by geographic divisions and States of total area of improved land on farms in the United States, 1869–1919 ..... 78

# THE DEVELOPMENT OF HORSEPOWER EQUIPMENT IN THE UNITED STATES

By Carroll Roop Daugherty

PREFATORY NOTE

In the academic year of 1924–25 it was the writer's good fortune to be one of a seminar group at the University of Pennsylvania which was studying the mineral and power resources and industries of the United States under the direction of Mr. F. G. Tryon, then chief coal statistician of the United States Geological Survey. The study of horsepower equipment as an index of the installation of machinery seemed to be a particularly appealing statistical problem, the mastering of which promised to be productive of interesting results. The findings in summary which were forthcoming after the year's work so fully justified this expectation that it seemed wise to enlarge the scope of the study and develop it, if possible, into a doctor's dissertation, in the hope of throwing light on a subject of broad interest among economists.

At all stages in the development of the thesis Mr. Tryon's suggestions and advice have been of valuable assistance. Acknowledgment is especially made to him for his unfailing interest, inspirational guidance, and kindly criticism. His intimate knowledge of the field made possible the use of many different kinds of source material.

The writer is indebted also to Mr. C. D. Kinsman, agricultural engineer, of the United States Department of Agriculture, for suggestions and material in connection with horsepower in agriculture and work animals. Mr. Kinsman has recently made an exhaustive and scholarly analysis of power used on farms in this country. His findings were used almost in toto.

Acknowledgment is made to the National Automobile Chamber of Commerce and to the Bureau of Statistics of the Interstate Commerce Commission for data furnished in their respective fields. In the preparation of the manuscript valuable suggestions and criticism were offered by Dr. J. H. Willits, Dr. A. H. Williams, Dr. R. T. Bye, Dr. Walter Voskuil, and Miss Anne Bezanson, all of the University of Pennsylvania faculty.

## INTRODUCTION

The United States of America undeniably leads the world in the production of wealth—in material prosperity. Especially has this been true since the World War. The other nations of the world, particularly the European industrial countries, have by contrast appeared to be in a sad plight. Unemployment, labor troubles, and financial difficulties have hampered the industries of England, France, and Germany, but on this side of the water there has been a relatively smooth flow, in huge volume, of goods for the satisfaction of myriad wants.

Naturally this unprecedented prosperity has attracted a great deal of attention both at home and abroad, and all thinking people have asked themselves the reason for it. To what cause or causes may it be attributed? From England two engineers were sent to study and analyze the situation. The recent book of one of our greatest industrialists telling the how and the why of our success is said to be selling very widely in Europe. And the fact that for the last year almost every good periodical and newspaper has devoted large amounts of space to the subject, in the form of articles or reports of industrial congresses and conferences, is evidence of a widespread interest in this country as well. The topic has appeared frequently on the editorial pages of newspapers.

All these discussions are much alike. They point out that the production of wealth has increased more rapidly than the population. There is therefore more wealth per inhabitant than before. As a reason for this increase is advanced the fact that more machinery is being used to-day in production; human labor is being supplanted by mechanical devices.

In the 50 years from 1869 to 1919 the population of the United States increased 2.76 times. In spite of the shift in population from the country to the city, so that only one-quarter of those in gainful occupations were employed in agriculture in 1919, while nearly one-half were so engaged in 1869, the agricultural production increased 4.94 times, or 80 per cent more rapidly than the population. During the same 50 years the products of mines increased 18.81 times, or nearly seven times more rapidly than the population. The manufactured products increased 9.61 times, or about 3.5 times more rapidly than the population. While many factors contributed to these increased outputs, the most important factor is undoubtedly the increased production and utilization of mechanical power by machinery. To-day the drudgery of the struggle for existence has largely been transferred to machinery vitalized by mechanical power, thus making universal education possible by sparing youth from the farm and the factory.[1]

And again,

All this power increases output and decreases sweat. While we have increased our manufacturing employees 65 per cent in the last quarter of a century, we have swelled productivity on a quantity basis in the neighborhood of 170 per cent. Our farms produce 37 per cent more with about 20 per cent more farmers; our railways carry about 170 per cent more traffic with 61 per cent more men. And with all we have in 25 years decreased the weekly hours of labor by about 9 per cent, while real wages have increased 40 or 50 per cent. The terrors of unemployment have been lessened.[2]

These statements reflect the general belief and attitude on the subject. It is undoubtedly true that more machinery and more power are at the service of the people of the United States than ever before; but there has never, it is believed, been a complete survey or

[1] De Baufre, W. L., address as retiring president of the Nebraska chapter of Sigma Xi, May 15, 1925; Science, new ser., vol. 62, p. 381, Oct. 30, 1925.

[2] Hoover, Herbert, The Nation's Business, June 5, 1926, p. 14.

exact measurement of these mechanical devices which are so greatly increasing our per capita output.

It is manifestly impossible, or at least impracticable, to make a census of the machines themselves. They change and become obsolete too rapidly, and they can not be reduced to any satisfactory common unit. But there is one way whereby an index of the installation of machinery may be obtained—by ascertaining the total horsepower of the engines that drive the different kinds of machinery. The engines may be of many different types, but their ability to operate machines may be expressed in terms of a single unit, the horsepower. The amount of mechanization of industry as a whole or of any one industry over a period of time may be judged by the horsepower capacity of the engines installed to drive the machinery in relation to the number of employees. If the total horsepower of the country's engines is appreciably greater now than it was 10 years ago, it may be said that there has been an increase in machinery installed. It is recognized that improvements in the technique of production or in transmission mechanism may increase the amount of machinery which can be operated by the same amount of horsepower. Nevertheless, it is believed that this difference is not large enough to impair the use of total horsepower as an index of the relative amounts of machinery in use over a period of years. Moreover, horsepower is the only index that can be used at the present time.

The aggregate horsepower of engines or motors, then, is roughly indicative of the amount of machinery installed and will be indicated by the term "horsepower equipment." It is figured only on engines that are properly designated "prime movers." A prime mover may be defined as an engine that utilizes the potential energy from some natural source (such as coal, wood, petroleum, or water) and converts it into the energy of motion. Thus steam engines and turbines, internal-combustion engines, and water wheels and turbines are prime movers. Electric motors, however, are not classified as prime movers because they do not utilize the original source of energy. They are run by electricity generated in dynamos, after the dynamos are set in motion by some prime mover.[3]

The purpose of this study is to present statistics of horsepower equipment as nearly as possible complete for all fields of productive activity in the United States. These statistics cover nine separate years spread over a period of seven and one-half decades, from 1849 to 1923. Naturally the censuses of the more recent years have yielded more exact information; there was less need for estimating for 1909, 1919, and 1923 than for the earlier years.

[3] In dealing with manufactures alone the United States Census treats the horsepower of motors driven by purchased electricity as "primary power," because for the purposes of the census of manufactures such power is in the same category as that obtained directly from prime movers.

This is not the first attempt to show the amount of horsepower equipment installed in certain fields,[4] nor is it the first time that an effort has been made to estimate the total amount existing in the country.[5] But it is believed that no information has yet been made available which is the result of a careful, thorough survey and analysis of all the primary horsepower equipment existing in all the chief fields of productive activity over a period of years.

In the present survey the equipment was apportioned among 10 fields of activity. For each census year horsepower data were gathered for manufactures, mines and quarries, agriculture, irrigation and drainage, electric central stations, electric railroads, steam railroads, ships, automobiles, and work animals not on farms. This apportionment made it possible to notice the trend in the use of equipment in any one field of endeavor and to determine the relative rank of any field at any one time.

The equipment was further classified, for the country as a whole and for each of the above-mentioned fields of activity, as to type of prime mover—steam, internal combustion, and water. Purchased electricity was also recorded for certain fields in which it stands in the same category as primary power, but the duplication thus involved was eliminated in computing the totals for the whole country. This classification made possible an analysis of the distribution and importance of the several types of prime movers at any one time and of the trend throughout the 75-year period.

Still another classification divided the equipment into three larger groups—"manufactures," including the horsepower in manufactures and that portion of electric central station equipment which is used for light and heat by consumers; "materials" (and food), including the horsepower in mines and quarries, agriculture, and irrigation and drainage; and "transportation," including the horsepower in electric and steam railroads, ships, automobiles, and work animals not on farms. "Manufactures" and "materials" were then combined for the sake of comparing equipment used to produce "form utilities" with that employed for the production of "place utilities." "Form utilities" are products which are changed in shape or form by the use of power. "Place utilities" are products which have value added to them by transportation. A further division of transportation horsepower was made in order to distinguish between "light" and "heavy" types, electric and steam railroads and ships being included under the latter and automobiles and work animals not on farms under the former. Finally, in order to portray the growth of

[4] See National Industrial Conference Board, A graphic analysis of the census of manufactures of the United States, pp. 139-202, New York, 1923; and Kinsman, C. D., An appraisal of power used on farms in the United States; U. S. Dept. Agr. Bull. 1438, 1925.

[5] See De Baufre, W. L., op. cit., p. 382; Mulhall's "Dictionary of Statistics," p. 549, 1892, for years before 1888; Low, F. R., Power resources past and present: Mechanical Engineering, January, 1925, p. 2.

electric equipment, the horsepower of electric central stations, of electric railroads, and of motors used in manufactures and mines to generate their own power was summed up in one group.

These statistics are presented for the 9 years in the 75-year period not only for the United States as a whole, but, as far as possible, for each of the 48 States and the District of Columbia and for each of the 9 major geographic districts into which the country is divided. This analysis discloses the growth of the different fields of activity over the several sections of the country.

This survey is primarily statistical. No effort is made to employ the different indices of horsepower equipment in any particular way, but a number of uses at once suggest themselves to the student. Some of these are pointed out on pages 36–42, but the actual development is left to subsequent studies.

It should be constantly borne in mind that the statistics here presented show horsepower equipment, not horsepower produced—that is, they show capacity, not use. None of the equipment is used 24 hours of every day. On the contrary, most of it is in use only a small fraction of the time. The figures, therefore, are an indication of what could have been, not a record of what was. This idea of the "use factor," as it is called, will be more fully developed in the following text, but it should be remembered throughout the discussion.

## SOURCES AND ACCURACY OF THE DATA

Inasmuch as the aim of this study is chiefly statistical—that is, to present data of horsepower equipment that may be used by the student of economics—the sources of the material and the method of obtaining the results should first be indicated. The data for certain years are more accurate and reliable than those for others, as explained in detail below. Facts of this nature will aid in the use of the statistics and in an evaluation of the results.

The totals for the United States are made up of statistics procured for each of 10 fields of activity—manufactures, mines and quarries, agriculture, irrigation and drainage, electric central stations, electric railroads, steam railroads, ships, automobiles, and work animals not on farms. The horsepower equipment in each one of these fields is engaged in some sort of productive activity. The last two, however, deserve special mention.

The field of automobiles is made up of passenger cars, motor cycles, and trucks. In 1923 the motor bus had not yet become an important factor in transportation, and the busses in use were generally included with passenger cars in registration figures.[6] Obviously the

[6] Facts and figures of the automotive industry for 1923, New York City, National Automobile Chamber of Commerce.

productive activities of passenger automobiles and motor cycles are as a whole very slight; it is only trucks that are used primarily for producing "place utilities" in goods to be consumed. The other cars are used chiefly for pleasure, as consumer's goods. Therefore, it has seemed wise to present figures both including pleasure cars and excluding them wherever their inclusion might distort the result and convey a false impression regarding the amount of equipment actually used in production.

Work animals not on farms were classed separately because it was impossible to apportion them among the other fields. Undoubtedly many are used in mines and others for general hauling.

In each field the total amount of horsepower equipment for each year was apportioned, so far as possible, among the different types of prime movers—steam engines, internal-combustion engines, water wheels, windmills, and work animals—and also purchased electricity, which is equivalent to primary power to the field using it. These details of prime-mover equipment in each field (exclusive of the purchased electricity, which would involve duplication) were then added to form totals for the country as a whole.

The data presented for the field of manufactures were obtained from the census reports, beginning with the year 1870. These volumes contain power figures for the United States as a whole and by States and for certain individual industries. Since 1920 the census of manufactures has been taken biennially. Not only are totals given, but also the amount of power installed by types of prime movers. There are no census figures of power for the years 1849 and 1859, and those here presented are pure estimates arrived at by plotting the increases of later decades and by extrapolation from the curve thus obtained, as well as by a consideration of other items that are reported for those years, such as number of employees and value of product. The data for 1849 and 1859 have thus less claim to accuracy than those for the later years; they are included as being of historical interest and indicating the small amount of power employed before the Civil War.

In the field of mines and quarries the census reports were again the source of material. No power analyses relating to this field are available for years before 1902. For these early years the data are scattered and incomplete. Figures for 1899 were based on the report for 1902, and those for the earlier years were estimated on the basis of the scattered material available and by extrapolation.

The material given for the field of agriculture was taken from an exhaustive study and analysis of power equipment used on farms made recently by C. D. Kinsman, agricultural engineer, of the United States Department of Agriculture.[7] Kinsman presents power sta-

[7] An appraisal of power used on farms in the United States: U. S. Dept. Agr. Bull. 1348, 1925.

tistics for the country as a whole from 1849 to 1924. His analysis is detailed in that he gives power equipment by types of prime movers as well as totals. He does not, however, offer data for separate States except for 1924, and the State figures included in the present study are estimated from the total for the country on the basis of improved farm acreage in each State, figures of which are available in the decennial reports of the census from 1850 to 1920. This basis seems to be more closely related to horsepower than merely all land in farms, inasmuch as power equipment is used almost wholly on land that is in crops or pasture. Improved acreage is of course not entirely indicative of the use of power as among States, for in some sections of the country certain types of farm activity are carried on which undoubtedly require a larger power installation than those of other sections. Nevertheless, it is believed that such discrepancy is not great enough to invalidate the results.

The census report for 1920 on irrigation and drainage contains data which give the equipment of pumping stations in this field for 1909 and 1919, both for the country as a whole and by States. These horsepower figures, however, are not separated according to types of prime movers. Effort was made to obtain such separate figures by correspondence with the Department of Agriculture, but they were not available. As the total amount is relatively small, an arbitrary separation was made so as to aid in forming the United States total for power by types of prime movers. The data for the years before 1909 are estimates based on the increase between 1909 and 1919 and correlated as far as possible with the census figures showing the acreage of land irrigated or drained.

In the fields of electric central stations and electric railroads total horsepower equipment and equipment by types of prime movers are given in the special census reports of 1902, 1907, 1912, 1917, and 1922. Figures for 1899, 1909, 1919, and 1923 were obtained by plotting the data given and then by extrapolation and interpolation, for the country as a whole and for the several States. No horsepower statistics are available for the years before 1902, but the number of electric central stations is given as far back as 1881; from these a power factor per central station was obtained and used in estimating power equipment for 1889 and 1899, to check the results obtained by extrapolation. A similar check was applied in the field of electric railroads by using the data given regarding number of companies, miles of track, and number of employees. Figures for the electrified divisions and tunnels of steam railroads are available in the later reports; these were included with electric railroads for 1909, 1919, and 1923. All material for the separate States in these two fields were obtained in the same way.

The statistics presented for the horsepower equipment of steam railroads for 1909, 1919, and 1923 are based on material issued by the Interstate Commerce Commission, giving average number of locomotives in service as far back as 1890 and average pounds of tractive force as far back as 1903. These two sets of figures for 1909, 1919, and 1923 were multiplied, the result expressing total tractive force in pounds for locomotives in those years. Horsepower figures are not given in the statistical reports of the Interstate Commerce Commission, inasmuch as horsepower varies with the speed of the locomotive. A formula supplied by the Commission's Bureau of Locomotive Inspection, however, was used to convert tractive force into horsepower. This formula, which assumes the average speed of all locomotives to be 11 miles an hour, is $\frac{T \times 11}{375}$, where T is the tractive force in pounds

The horsepower equipment on steam railroads for the years 1849, 1859, 1869, 1879, 1889, and 1899 was estimated as follows: Poor's "Manual of railroads" gives the number of locomotives back to 1877 and track mileage back to the beginning of construction. An average factor was obtained expressing the relationship between these two items. This factor was applied to the track mileage for the early decades, as it was fairly constant over a period of years and it was assumed to be applicable as far back as 1849. The number of locomotives having thus been estimated, the average tractive force for the same years was computed by means of the formula given in the handbooks issued by the Baldwin Locomotive Works, namely $\frac{C^2 \times S \times P}{D}$, where C equals the diameter of the cylinder in inches, S is the stroke of the piston in inches, P the mean effective boiler pressure in pounds, and D the diameter of the drive wheels in inches. A number of books were read in order to get these dimensions in early locomotives representative of their time. The figures for tractive force thus obtained were then converted into horsepower by means of the first formula given above. It was found impossible to estimate steam-railroad horsepower equipment by States. No data are available giving number of locomotives or ton-miles of freight for each State, inasmuch as most lines operate in more than one State. Track mileage per State was considered unsuitable as a basis for estimates, because it fails to indicate heaviness of traffic—that is, the amount of power used in different sections of the country varies widely over similar lengths of track, owing to differences in the density of traffic and in grade of road bed.

Horsepower figures for vessels engaged in river, canal, lake, and coastwise transportation were tabulated from statistics contained in the annual list of merchant vessels compiled by the Bureau of Navigation of the Department of Commerce. The figures in the lists for

1909 and 1919 were added, giving totals for horsepower and gross tonnage. Separate statistics for vessels using steam and internal-combustion engines were not obtainable before 1915. A horsepower factor per gross ton for each of these types of vessels, however, was worked out for 1919 and 1923. For 1909 a horsepower factor per gross ton of all vessels was used, and as horsepower data were very incomplete for vessels before 1910 it was assumed that the same factor was applicable to the earlier years. These factors were then applied to figures of gross tonnage, obtained from the annual reports of the Commissioner of Navigation, for the United States as a whole back to 1849 and for States back to 1889, thus yielding data for horsepower equipment in this field.

Perhaps the greatest difficulty was experienced in obtaining trustworthy estimates of horsepower equipment in the field of automobiles. Two items were necessary—the number of passenger cars, motorcycles, and trucks for the four years covered (1899, 1909, 1919, and 1923), and the average horsepower of these vehicles. The first item was obtained as follows: Total figures of registration from 1895 to 1923 were given in the 1924 issue of "Facts and figures of the automotive industry," published by the National Automobile Chamber of Commerce. These were checked by similar data furnished by the Bureau of Public Roads of the Department of Agriculture, and by the statistical issues of the magazine Motor. Unfortunately, no one of these sources gave any indication of separate registration by passenger cars, motor cycles, and trucks for the years before 1914. Figures for production of passenger cars and trucks, however, were available as far back as 1899, and an approximation of correctness was effected by applying to the registration for the early years the ratio of such production to total registration for the later years. The second essential item, the horsepower average to be applied to the number of vehicles, was found in this fashion: At first it was thought that the figures of horsepower published by Automotive Industries would be adequate, but it was discovered that many of these figures, which represent "rated" horsepower and are used only for purposes of taxation, were much lower than the actual horsepower capable of being developed in automobile engines, known as "brake" horsepower. Data for computing "brake" horsepower were then obtained in two ways—by writing to the leading car and truck manufacturers of the country in order to ascertain the horsepower of all old and recent models, and by consulting the engine specifications of cars in the statistical issues of Motor for the years 1910, 1920, and 1924. The final problem was to give due weight, as far as possible, to the horsepower of the different types of cars. Most weight naturally belonged to the cars that were most numerous. Study of volumes of production given in Motor led to the conclusion that

about half of the automobiles represented in the registration figures were Fords and that the other half was made up in general of three types of cars—the high-priced, luxury car, of which there were fewest in use; the middle-class, medium-priced car; and the most used, low-priced car. An average horsepower figure was struck for each group. The first was weighted 1, the second 3, and the third 5. The weighted mean then obtained was applied to the other half of the registration total. The total horsepower obtained by this means is believed to be fairly reliable. It is at least indicative of the enormous growth in the use of this kind of transportation. Registration by States has been reported only after 1914, so that horsepower data for different sections of the country could be presented only for 1919 and 1923.

The material for work animals not on farms came from the report by C. D. Kinsman already cited. The figures are available for every year covered by the tables, but apportionment among States was impossible.

After the data had been collected and classified for each field in the manner just indicated, they were combined and used in a number of different ways. The amounts of horsepower equipment in the different types of prime movers in each field were summed up in order to show their relative importance and rates of increase for the country as a whole. The figures thus obtained indicated what kinds of energy were being most used in any one decade and disclosed any changes in their relative proportions. There is much concern at present as to the past importance and the probable future significance of coal and fuel oils compared with such other sources of energy as water and wind. It is hoped that the analysis discussed above throws some light on this question.

The amounts of equipment in each field were combined for each decade in larger groups, chiefly for the purpose of comparing power used in the different types of industry—manufacturing, mining, and agriculture—with that used in transportation.

It is believed that the chief value of the statistics presented in this study will be to show that horsepower equipment has increased more rapidly than population or number of wage earners—in other words, that there has been a steady growth in the horsepower equipment per capita and per wage earner over the entire 75-year period, both for the country as a whole and for those fields of activity in which number of wage earners can be separately ascertained. An index of this increase may then be used for comparison with indices for other ratios, such as volume of production per wage earner or amount of wages per wage earner.

The population and total number of wage earners in the country were obtained from the census reports for each year except 1923 and

compared with total horsepower by means of index numbers. The figures for 1923 are estimated on the basis of past growth and on the basis of a similar estimate made by the National Electric Light Association. Numbers of wage earners were ascertained for 7 of the 10 fields of activity—manufactures, mines and quarries, agriculture, electric central stations, electric railroads, steam railroads, and ships. The data on manufactures for the whole period are obtainable in the census reports on manufactures. Those on mines and quarries come from census reports on occupations up to and including 1919; the figure for 1923 is estimated from past growth, no other complete sources being available. The material in the column of agriculture is taken from the work of Kinsman. The number of wage earners in electric central stations and electric railroads was determined from material in the special census reports by extrapolation and interpolation. The statistics issued by the Interstate Commerce Commission give for each year the number of wage earners on steam railroads. The census reports on occupations furnish the basis for the statistics of wage earners on ships up to and including 1919, and the figure for 1923 is an estimate based on past growth and compared with tonnage.

In general the accuracy of the statistics presented in this study increases with each successive decade. The data for the early years are almost wholly estimated, but it is believed that the estimates are supported by bases accurate enough to lend a degree of authenticity to them. Census taking in the later years has become more efficient and more inclusive, and consequently the most accurate figures are those for 1909 and 1919. Estimates had to be made in certain fields for 1923, as 1920 was the most recent census year, but these estimates are relatively reliable because their bases come from recent trustworthy sources. The latest year for which accurate statistics are available in most of the 10 fields of activity is 1923, and for that reason the study has not been extended into more recent years. Any material presented for years later than 1923 would be almost wholly estimated from incomplete sources. There are no statistics for manufactures after 1923, for mines after 1920, for agriculture after 1924, for irrigation and drainage after 1920, for electric central stations and electric railroads after 1922, for steam railroads after 1924, for ships after 1926, for automobiles after 1926, and for work animals not on farms after 1920.

Every effort was made to include in this survey all the horsepower equipment in the country. However, there are some items for which no data were available nor even any material that could be made the basis for a fairly accurate estimate. For example, no information could be obtained from any source on the amount of equipment in use in the field of building and construction. De Baufre, in his

article cited above, makes an estimate of 4,000,000 horsepower in nonindustrial fields, but he does not state what is included in or formed the basis for this figure. Again, no information was available regarding the amount of equipment owned and used by hotels, office buildings, and public buildings, some of which generate their own heat and light and furnish the power for their own elevators.

On the other hand, data were obtained for some other items as set forth in the following paragraphs, but they are not included in the grand total, chiefly because they are of little or no importance in production.

There is about 700,000 horsepower in engines used for pumping in the cities of the United States. This figure was arrived at by obtaining from 10 of the largest cities the rated capacity of their pumping equipment and then applying this total so as to get the equipment of the whole urban population. The details are presented in Table 35.

The horsepower of engines used in the airplanes of the United States Army amounted in 1925 to about 475,000. It was impossible to obtain data for commercial flying machines, as no registration is required for them.

The United States Navy commands a large horsepower equipment. In 1924 there was 11,000,000 horsepower in the navy battleships, cruisers, destroyers, submarines, patrol vessels, auxiliaries, aircraft, and district craft.

Another place where horsepower equipment might be found is in amusement parks and similar resorts. Inquiry has elicited the fact, however, that most of the power used in such places is purchased, in the form of central-station electricity.

There are some small items of horsepower which are not included in the totals published in the census of manufactures. The statistics of manufactures up to and including those of 1900 took in neighborhood hand and building industries, as well as factory industries, but all later censuses have embraced only the statistics on factories. In the later reports the data before 1910 have been reduced to the new basis for purposes of comparison.

On page 521 of volume 8 of the Census for 1920 is found a list of classes of establishments that were not canvassed for horsepower. Places having an annual output valued at less than $500 were not reported. No data were obtained for the various building industries—architects' work, bridge building, building and construction work, carpenter shops and contracting carpenters, electric wiring and construction work, excavating and well digging, masonry, brick and stone work—or for moving and raising buildings, paving and laying stone and concrete, plumbing, gas and steam fitting, roofing, or railroad construction. Establishments making building supplies and

materials, however, were included. Other industries omitted in the census, which might have had a small amount of mechanical power, are bicycle-repairing shops; blacksmith shops; locksmith and gunsmith shops; garages; various other repair shops; establishments making costumes for rent only; cotton cleaning and rehandling; cotton compressing and cotton ginning; dentistry; packing, dressing, and shipping poultry except as done on a large scale by meat-packing firms; fisheries; hay and straw baling; ice harvesting (ice manufacturing is reported); rectifying and blending liquors; salting hides; stone crushing in connection with construction work (stone crushing as a business for selling to public is reported); tobacco stemming and rehandling; bottling, unless done by establishments in which beverages or sirups are made; dairies; and manufacturing carried on in educational, eleemosynary, and penal institutions. Most of the establishments enumerated above, however, are so small that in all probability they use purchased electricity to run their few machines. This electricity would be reported under electric central stations.

Finally, the census reports the horsepower equipment of the following establishments but does not include it in the total for manufactures; Governmental manufacturing establishments, 173,000 horsepower; power laundries, 197,000 horsepower; dyeing and cleaning, 24,000 horsepower; custom sawmills, 131,000 horsepower; custom gristmills, 219,000 horsepower. The total is 744,000 horsepower, a not unimportant amount. These figures are for 1919. (See Table 34.)

## DEVELOPMENT OF PRIME MOVERS

Two obvious but significant considerations must be remembered in the study of the phenomenal growth in the use of prime movers. First, without inventions and improvements in prime movers, including advances made in fuel utilization, there could have been no substitution of mechanical for hand labor, with the resulting reduction in the cost of power and product. Second, inventions and improvements were necessary also in the machines that used the power, for even if power was available it could not be employed unless machines were ready. In general, however, it is true that improvements in both fields have kept pace with each other.

A few of the chief technical advances that have been made, mainly in this country, in the improvement of prime movers will be briefly set forth. The writer makes no claim to original research on this topic. The material presented is well known to most students and is introduced to serve as a background for the ensuing discussion. No attempt will be made to cover the field suggested under the second point above.

The technical side of a discussion on horsepower equipment may be divided into two parts—generation of power and transmission of

power. The first deals with the making of kinetic energy out of the potential energy of natural resources such as coal, oil, and water. The second deals with devices that connect this energy of motion to machines which do man's work. The story of each of these phases falls roughly into three periods—the colonial period, lasting till 1790; the period from 1790 to 1860; the period from 1860 to the present time.

During the colonial period the industrial situation in this country was similar to that existing in England before the industrial revolution. The manufacturer was a man who owned a small mill or operated a forge, and in colonial parlance a mill meant either a grinding contrivance or any machinery operated by hand, animal, wind, or water.[8] These were the chief types of power in use at that time, and they came to be employed in the order named. Hand power was first used everywhere in forges and for grinding. The utilization of animal power came next, horses and cattle being used where absence of water power, pecuniary inability, or sparseness of population made it impracticable to use power of any other type.[9] Wind was used to turn the wheels of gristmills and sawmills at an early date. Windmills were found chiefly among the Dutch settlers in New York, although there were a considerable number in New England. Indeed, the first mill to be operated in that section of the country was one propelled by wind near Watertown, Mass., in 1632.[10] Most of the small colonial establishments, however, were operated by water power. The ample fall and precipitation of the Atlantic slope provided many watercourses on which power could be developed. At that time the smaller creeks and rivers of New England and the central colonies were used much more for power than now. The larger water powers were not developed till after the Revolutionary War. Small enterprises were the rule. In these mills "most of the wheels were undershot and utilized only a fraction of the water power applied to them. Power transmission was so little understood that a separate wheel was generally necessary for each unit of machinery. The wheels and most of the mechanism were of wood. The invention of improvements by which several kinds of apparatus—threshing and winnowing machines, grist and bolting mills, flax beating and cleaning machinery—could be operated by a single wheel is attributed to a Connecticut mechanic [Joel Harvey], who not long before the Revolution received a prize from the London Society of Arts for his devices. Any part of the machinery could be discon-continued without impeding the rest."[11]

[8] Clark, V. S., History of manufactures in the United States: Carnegie Inst. Washington Pub. 215, p. 174, 1916.

[9] Bishop, G. L., History of American manufactures from 1608 to 1860, vol. 1, p. 116, 1861.

[10] Idem, p. 117.

[11] Clark, V. S., op. cit., p. 175.

The steam engine was of no importance as a prime mover in colonial manufactures. It had only just been proved practicable and was yet in the experimental stage. Watt's engine was patented in 1769, but it did not become a really established factor in the economic life of Great Britain until the colonies had won their freedom. On this side of the water a number of men were working on production of power by steam. Jonathan Hornblower, Christopher Colles, Barnabas Deane, James Fitch, Henry Voight, and Oliver Evans are the names of pioneers in this field. The work of Evans is particularly worthy of note. It was he who first experimented successfully with the high-pressure steam engine about 1775. This type of engine was far superior to the former low-pressure devices, although it required much more careful handling. The mechanical horsepower equipment used in the colonial period was thus scarcely advanced beyond the experimental stage.

In the second period, however, up to the Civil War, the factory system of manufacture began to develop, and a number of improvements were effected. At first the very fact that water power was so plentiful and inexpensive led to wastefulness in its use. Managers of enterprises chose to employ cheap water wheels rather than invest in more expensive ones which by their more economical utilization of water would have amply justified the extra cost. Until 1840, for example, wooden pitchback wheels were used which turned inward toward the fall, the water striking them just short of their highest point, the impact or kinetic energy of the falling water being thus lost. Eight such wheels 30 feet in diameter, with buckets 12 feet long to catch the water, constituted the power equipment of the Merrimac Co. at Lowell, Mass.[12] These wheels utilized about three-fourths of the power applied to them. This Lowell development was typical of the way in which cotton manufacturers had been using water power ever since the initial successful use of wheels of this type for cotton manufacture in 1790 at Pawtucket Falls.[13] The larger streams were developed. A system of canals was built on the inner side of a bend in a river, enabling the running of many wheels at different levels by the same stream. The wheels were all of the overshot type.

It is believed that the introduction of the first steam-engine mill at Providence, R. I., in 1830 stimulated the search for a more efficient way to utilize water power. Interest turned to the hydraulic turbine. This prime mover had reached its greatest perfection in France. It had been tried in this country in 1790, but the experiment was a failure. Soon after 1840 the Franklin Institute of Philadelphia published accounts of the French wheels which led to

[12] Clark, V. S., op. cit., p. 406.
[13] Lucke, C. E., Power, p. 230, Columbia Univ. Press, 1911.

experimentation and resulting proof of their greater efficiency and cheapness.[14]

There is some difference of opinion as to when the hydraulic turbine was first used in this country,[15] but it is safe to say that by 1845 there were two or three in successful operation. Ten years later hydraulic turbines had displaced most of the pitchback wheels at Lowell and had been introduced from the first in the new factories at Lawrence. Their use added about one-fourth to the power utilized at these cities.[16] The introduction of the turbine was the first step toward the modern hydraulic plant. Although invented in France, the modern turbine owes its development chiefly to improvements made by American engineers. Turbine development, however, was forced to wait upon advances in the technique of metal working.[17]

Steam engines, to the introduction of which was partly due the marked improvement in the economical utilization of water power, were installed slowly at first. During the first third of the nineteenth century the location of factories was determined chiefly with reference to water power. But improvements in the steam engine led to their increasing use during the later half of this period.

Two general designs of engine came into early use—the low-pres sure Boulton & Watt type, imported from England and also built in America, and the high-pressure type, made by Oliver Evans in Philadelphia, which was able to compete actively with the low-pressure engine and which was in some respects superior. The high-pressure engine was more satisfactory for use in factories, and, although it required more fuel, was simpler to build.[18]

The invention of the crank shaft by Watt in 1784 changed the reciprocating motion of the engine piston to the rotary motion of a shaft, and the use of all the expanding power of steam in triple-expansion engines is another outstanding improvement in this period. But perhaps the greatest advance, so far as factory use is concerned, was that made in the new Corliss engine of 1849. This engine possessed a much more sensitive governor, called variously a "valve gear" or "rotary valve" or "drop cut-off," which enabled engineers not only to keep the speed of the engine much more uniform than before but to regulate the speed in accordance with the require-

[14] Clark, V. S., op. cit., p. 407.

[15] Clark (op. cit., p. 407) says that the first to be used practicably in New England was built in 1843 by George Kilburn for the Fall River plant of Robeson & Sons. He also mentions the turbine installed at the Appleton Mills, in Lowell, Mass., designed by Uriah Boyden. This 75-horsepower turbine could reach an efficiency of 88 per cent. In 1845 another Fall River mill was equipped with a turbine. C. E. Lucke gives Boyden's 1844 engine as the first installation.

[16] Clark, V. S., op. cit., p. 408.

[17] Freeman, J. R., Water-power production in the United States: World Power Conference Rept., vol. 2, p. 374, 1924.

[18] Clark, V. S., op. cit., p. 409. Kaempffert, Waldemar, A popular history of invention, vol. 2, p. 484, 1924.

ments of the particular factory. Spindles and looms, for example, could be driven continuously at the speed required for the best type of product. In addition to affording evenness of operation, the Corliss engine permitted appreciable economies in fuel utilization.

The third chief type of prime mover, the internal-combustion engine, was not developed to practical use during the period before the Civil War, but a great deal of experimentation was being done with the idea of moving a piston by means of expanding gases. In fact, ever since 1678, when the Abbé de Hautefeuille used an explosion of gunpowder to drive a piston in a cylinder, men had been working on the problem.

In considering the progress made during this period, it must be remembered that the difficulty of working metal to exact dimensions retarded the development of prime movers. In the early steam engines, for example, the lever beams, the arms and shafts of the fly wheels, the bearings, and even the boilers and other parts were made of wood. Advances in engine design depended in part on improvements in iron working.

It is since 1860 that the most rapid strides have been made in power development. Technical advances in subsidiary industries and new demands for power made by the growing industrialism of the country have furnished ample impetus.

One outstanding invention has appeared in the field of water power. This was the Pelton wheel, first used successfully in 1884 at the Chollar mine, in the Sierra Nevada.[19]

The steam turbine was the major development in steam utilization during the later half of the nineteenth century. Engineers had experimented with the idea ever since Hero, of Egypt, had made his crude toy about 100 B. C., but it had never been of practical use because of its high speed. Not until the high-speed electric generator was invented did it find extensive employment.

An extremely interesting development of recent date is the use of mercury vapor instead of steam to operate turbines. Mercury is vaporized in a specially constructed boiler, passes through a turbine, where it does useful work, and exhausts into a surface condenser, where its latent heat is used to make steam that drives an ordinary turbine. The condensed mercury is returned to the boiler and used again. The advantage of this system is due to the facts that mercury can be heated to a high temperature without developing excessive pressure and that the heat of condensation can be utilized for making steam at pressure desirable for use. The utmost care, however, must be exercised to prevent the escape of the highly poisonous mercury vapor. A system of this type was installed in 1923 by the Hartford (Conn.) Electric Light & Power Co. It is reported that the

[19] Kaempffert, Waldemar, op. cit., p. 536.

experiment has proved highly successful and that the fuel bill has been about halved.[20]

The internal-combustion engine was developed about the time of the Civil War. The Lenoir motor, which marked a distinct epoch in gas-engine construction, appeared in 1860 and was the first engine of this type that performed with relative smoothness and efficiency; but it used fuel rather wastefully. The Lenoir engine was followed in 1862 by an engine invented by Beau de Rochas, who introduced the modern system of four-cycle operation. This engine was placed on the market in 1878 by Otto, after whom the four-cycle idea is sometimes named. In 1879 Clerk brought out his two-cycle engine. Both these types are used to-day, but the four-cycle engine is the prevailing type.

Many small improvements have been effected in these engines, but there has been only one notable and significant development in the internal-combustion field since 1880—the Diesel engine, which utilizes the four-cycle principle. The chief difference of the Diesel from other internal-combustion engines is that instead of an electric spark being used to ignite a charge of fuel vapor, injected air is so greatly compressed in the cylinder that its heat fires the fuel, which is injected into the cylinder at the completion of compression.[21] Great economies are claimed for the Diesel motor, one of which is that heavy oils may be used to advantage.

The chief use of the internal-combustion engine has been in the province of transportation, where its advantages are obvious. It has failed to advance as a source of electric generation, mainly because to build it in the large units required in central stations has been impossible. Diesel engines, however, are gradually being increased in size and are successfully competing with steam-driven prime movers.

Remarkable as has been the growth in the total capacity of this kind of prime mover and supreme as it is in its own field, another equally outstanding power achievement since 1860 has been the development of electricity. In many ways electricity is unsurpassed as a form of power. The electric generator and the electric motor are, of course, not prime movers, but the current produced by one and used by the other has enabled this country to use sources of power which otherwise would be largely untouched and to put this energy at the disposal of almost every inhabitant.

Although the relation between electricity and magnetism was discovered and known in the first half of the nineteenth century, it was not until 1870 that these principles were used in a practical way. At this time Gramme, a Belgian, produced a workable generator yield-

[20] Kaempffert, Waldemar, op. cit., p. 502.
[21] Hogle, W. H., Internal-combustion engines, p. 17, 1909.

ing a direct, continuous current. Three years later, at a Gramme exposition in Vienna, it was accidentally discovered that a dynamo is also a motor if electric current is applied to it. This was the curious beginning of the electric power industry.

The first electric central station in the United States was the one built by Edison at New York City in 1882. The current in this and all the other early plants was used for lighting. Industrial uses were to come later. The first hydroelectric station began operation in the same year at Appleton, Wis. In 1885, at Great Barrington, Mass., a notable advance was made in the first successful commercial use of alternating current for lighting. The year 1887 saw the first electric street railway in this country in operation at Richmond, Va.

Most of the developments in the field of electricity, however, have been made in connection with transmission. These improvements have paved the way for what some choose to call "the second industrial revolution" and have made possible the location of factories at comparatively long distances from the sources of power. The transformer idea was contributed by Faraday about 1845, but it was of no practical use until 1888, when Tesla invented both the multiple transformer and the polyphase electric motor for alternating current of high frequency. Alternating current being far superior to direct current for transmission, the way lay open for subsequent advances. There have been no unusual or radical changes since then—merely the gradual improvements which so often follow in the wake of a great invention. The chief of these improvements have been protection against lightning and better insulation to guard against loss of current.[22]

Long-distance electrical transmission of energy in the United States dates from 1893, when the polyphase system was first used for carrying a current of high voltage from the plant of the San Antonio Light & Power Co., at Pomona, Calif., to San Bernardino, a distance of about 19 miles. The original current of 1,000 volts was stepped up to 10,000 volts. This pioneer effort was followed by other plants. To California, with its ample water power in the Sierra Nevada many miles from centers of population, belongs the credit for the biggest development in electrical transmission. By 1900 a pressure of 40,000 volts had been attained. In 1909 this was increased to 110,000 volts, and in 1923 a high-tension line transporting 220,000 volts was put in operation in this State.[23]

But there were achievements in the transmission of electric current in other sections also.[24] Niagara River, although furnishing a much smaller "head" than was often found on the Pacific coast, provided a larger volume of water. Electricity generated by turbines at

[22] World Power Conference Trans., vol. 3, p. 1110, 1924.
[23] Idem, p. 1111.
[24] Census of Manufactures, 1900, vol. 7, p. cccxxii.

Niagara Falls was transmitted 23 miles to Buffalo in 1895. Another noteworthy contemporary performance was that at Sault Ste. Marie, where a canal about 2 miles long developing a head of about 20 feet was constructed along St. Marys Falls, at the outlet of Lake Superior into Lake Huron.

Although electricity furnishes the most striking attainments in the field of transmission, the other methods of hooking up machinery to the power afforded by prime movers must not be overlooked. There are three main means of transmission.[25] First, the motion of a prime mover may be carried over directly by such devices as gears, belts, sprockets, or ropes and pulleys. Second, it may be transmitted over longer distances by pressure. Water, in hydraulic mains, and air, used like steam to run engines or drills, come under this classification. The third system is not dependent on push or pull but involves a transformation of energy from a form not easily transmitted to another that is—for example, electricity stepped up in voltage by means of transformers and sent over long distances and gas sent through pipes to engines.

As regards the first method, there is only the need to note that during colonial times wooden cogs and shafts were used. These were followed by metal gears, but by 1830 it was proved that belting was superior. Although gearing is most suitable under some circumstances, belting still remains the best means of transmitting power over short spaces. Much study on the subject has resulted in numerous improvements, perhaps inspired chiefly by the high speeds necessary for metal cutting.

The transmission of power over distances by water, air, or gas is not important industrially and is of only local significance.

## CERTAIN FINDINGS OF THE STUDY

A number of interesting trends appear from a survey of the accompanying tables and charts. Although the chief aim of this study is the presentation of the data as a reference compilation of material from a number of scattered sources, an outline of certain chief findings to which the statistics point is not entirely beyond its scope.

In Table 1 and Figure 1 is shown the total horsepower of prime movers installed in the different industrial activities in this country for each census year from 1849 to 1923. From 10 millions it has grown to the astonishing total of 684 millions of horsepower, more than sixty-eight times as much. Each decade has witnessed a steady increase, but since 1899 the development has been marvelous. Before that time the increase in any 20-year period had never been much more than twofold, but in the 20 years from 1899 to 1919 the growth

[25] Lucke, C. E., op. cit., p. 266.

was more than sixfold. Only four years later, in 1923, the total was over ten times that for 1899.

The chief reason for this recent enormous growth is the increasingly extensive use of the internal-combustion engine in the pleasure automobile. Over 450 million horsepower, or almost two-thirds of the 1923 total, belongs to this class. This equipment is, for the most part, not really productive. Therefore the table also presents figures for the later years which show the amount of equipment exclusive of that assignable to pleasure vehicles. Here the growth, though pronounced and rather more rapid than before 1899, is more even. The total in 1923 was about twenty-three times that in 1849 and more than three and one-half times that in 1899.

Table 1 furnishes a picture of the continual growth of the capacity of prime movers over a long period of time, gathering speed and momentum with each decade. A more detailed inquiry, however, is necessary to determine the exact nature and trend of this increase.

Table 2 shows the installed capacity of prime movers in the different industrial activities, the distribution of the total horsepower of prime movers in each census year in percentages of the yearly total among the different activities, and the relative growth of the capacity of prime movers installed in each activity. The capacity as given in this table represents the horsepower of prime movers owned by the establishments reporting them. The capacity of any prime mover is included but once and only in the activity reporting it. There is therefore no duplication of horsepower capacity in this table.

Table 3 shows the horsepower utilized in the activities given in Table 2. The figures in this table include the horsepower of owned or installed prime movers in each activity and the horsepower of electric motors or other equipment in each activity driven by purchased electrical and mechanical power. This table therefore contains some duplication, the amount of which may be ascertained by comparing the figures with those in Table 2 for the same activities.

It is at once apparent from an examination of these tables that there has been a remarkable increase in motor-driven vehicles. Although the automobile was in its infancy as recently as 1899, its growth has been tremendous, there being nearly sixteen thousand times as much horsepower in automobile engines in 1923 as in 1899. This remarkable increase in automobiles is due mainly to the use of the automobile for pleasure. Passenger cars and motorcycles, which may be considered as being used mainly for recreation, represent about 90 per cent of the total horsepower as well as of the total number of automobiles in 1923. (See Table 31.) This rapid increase in automobiles since 1899 so distorts comparisons of the relative amount and growth of power in other activities that figures of capacity are given with the horsepower of pleasure automobiles omitted.

61750—28——3

The next largest increase in capacity of prime movers is in electric central stations, which show a gain from 120,000 horsepower in 1899 to 22,000,000 in 1923. Second in rank in total capacity to automobiles come steam locomotives, indicating the importance of railroad transportation.

Agriculture ranks third in capacity of prime movers. Up to 1869 and later more than half of the total capacity of prime movers in all activities was installed and utilized in agriculture. The vast industrial development in the United States that was well under way at the beginning of the century called for so much power that prime movers in agriculture gradually became of relatively less importance in each decade, but nevertheless the capacity of prime movers in agriculture still holds third place.

In general, transportation activities have increased more rapidly than the activities that produce "form utilities"—manufactures, mines and quarries, and agriculture.

The use of purchased power has increased rapidly, and to this development in the power field is due the rapid growth of electric central stations. A comparison of Tables 2 and 3 shows how extensive the use of purchased power has become. For example, manufactures in 1923 purchased power to operate more than 13,000,000 horsepower of electric motors, and electric railways purchased power to operate about 2,500,000 horsepower of motors. The utilization of purchased power [26] will probably continue to increase, as power can be produced more economically in a large central station with its high load factor resulting from large diversified load than in small plants with the low load factors that are the rule in such plants.

It may be interesting to compare the figures in Table 1 with a previous estimate of horsepower over a period of years, given in Mulhall's "Dictionary of statistics," page 549, 1892:

[26] The following figures are given in the Electrical World, Jan. 2, 1926, pp. 28, 44:

| | Jan. 1, 1924 | Jan. 1, 1925 | Jan. 1, 1926 |
|---|---|---|---|
| Total domestic lighting customers | 11, 623, 644 | 13, 406, 777 | 14, 532, 930 |
| Total commercial lighting customers | 2, 258, 347 | 2, 588, 983 | 2, 781, 280 |
| Total industrial power customers | 502, 736 | 570, 844 | 622, 950 |
| | 14, 384, 727 | 16, 566, 604 | 17, 937, 160 |

The lowering in the rate of increase of lighting consumers is laid to the decrease in building operations and the approach toward saturation point; but industry is said to be far from saturated (p. 44), as it is only 65 per cent electrified, and of this 32.4 per cent comes from privately owned generating plants. In the whole manufacturing power field, therefore, the maximum potential load of the country's central stations has been only 44 per cent developed.

Some industries, of course, present an almost impossible barrier to electrification. Such are those which use coal for heat as well as for steam power—for example, blast furnaces, factories making clay and glass products, oil refineries, and textile finishing mills.

*Estimated horsepower of prime movers, 1840–1888*

| Year | Fixed | Locomotives | Steamboats | Total |
|---|---|---|---|---|
| 1840 | 360,000 | 200,000 | 200,000 | 760,000 |
| 1850 | 600,000 | 600,000 | 500,000 | 1,700,000 |
| 1860 | 800,000 | 1,800,000 | 900,000 | 3,500,000 |
| 1870 | 1,216,000 | 3,300,000 | 1,100,000 | 5,616,000 |
| 1880 | 2,186,000 | 5,700,000 | 1,200,000 | 9,086,000 |
| 1888 | 3,300,000 | 9,300,000 | 1,800,000 | 14,400,000 |

In this table locomotives are arbitrarily considered as being of 300 horsepower each, and the horsepower of steamboats is considered equivalent to their tonnage. "Fixed horsepower" evidently means manufactures, as it is estimated before 1870 on the basis of "number of hands."

W. L. De Baufre (Science, Oct. 30, 1925, p. 328) estimates the grand total to be about 500,000,000 horsepower for 1925. F. R. Low (Mechanical Engineering, January, 1925, p. 2) makes an estimate of about 700,000,000 horsepower for the same year. (See p. 35.)

A second manner of analysis concerns itself with the growth of horsepower equipment among the different types of prime movers. In Table 4 (A and C) and Figure 5 it is evident that the most rapid development has taken place in internal-combustion engines. This was to be expected from what is known about the large number of automobiles in existence, but even if the capacity of pleasure cars is deducted from the total, the item of trucks is still great enough to give this type of prime mover first place in rate of increase. Steam power, which is still the country's greatest single prime mover, has developed steadily but not so rapidly as water power. Undoubtedly hydroelectric developments have caused the rapid rate of growth since 1899. Windmills have never been of much importance, although their use has gradually increased. An interesting story is told in the column showing the decreasing number of work animals since 1909. This decrease is coincident with the use of mechanical devices on farms and in transportation.

Table 4 (B) and Figure 5 picture the transition of the country from the early stage, in which animals were chiefly used to perform the work of man, to the present time, when work animals have been supplanted by machines. Nevertheless work animals still represent more horsepower than water wheels. If the item of pleasure automobiles is subtracted from the internal-combustion quota, steam power has made up over half of the total since 1889. In 1923, however, its rank was reduced by internal-combustion power, which amounted to almost one-third of the total.

Several main points of interest come to light in the presentation in Table 5 and Plate 1 of the percentage distribution of prime movers in each of the fields of activity. The increasing use of purchased

electricity in manufactures and in mines and quarries is worthy of note. In agriculture work animals are still almost of first importance, being topped in 1923 only by internal-combustion equipment. Steam and purchased electricity are little used in agriculture, because they involve stationary power units, and most of the work on farms requires tractive force. Steam-driven prime movers form the chief type in electric central stations and electric-railroad power plants, although in the central stations water wheels amount to almost one-third of the total. The sailing vessel has been supplanted by the steam-driven ship ever since the Civil War. The use of internal-combustion engines for driving ships is increasing, and the horsepower of Diesel engines used to operate ships may reach a considerable figure, especially if there is no pronounced increase in the cost of fuel oil.

Certain major groupings of horsepower equipment are shown in Table 6 and Figures 6 and 7. Power in the division "manufactures" has increased at a more rapid pace than in the division "materials," although the latter exceeds the former in absolute amount in every census year. But, as would be expected from the inclusion of pleasure automobiles, the division "transportation" has grown most rapidly of all. After 1899 it also exceeds the others in absolute amount. The rate of development in "manufactures and materials" shows an average of the rates of the two groups of which it is composed and is more satisfactory for comparison with the "transportation" division, for it represents all the equipment used in producing "form utilities," whereas the equipment credited to "transportation" is used in producing "place utilities." In absolute amount the "manufactures and materials" group exceeds the "transportation" group up to and including 1899, but after that "transportation" forges ahead. The increase in "manufactures and materials" from 1849 to 1923 is over eleven and one-half times, and from 1899 to 1923 almost two and one-half times.

It is a striking fact that for more than 15 years so much more equipment has been installed for moving persons and goods from place to place than for making things. In so far as this difference is caused by equipment used for carrying the products of manufactures, mines and quarries, and agriculture, the conclusion that geographic specialization of production has gone far in this country is verified. And in so far as it is the result of equipment used for transporting persons, it may be cited as evidence supporting the conclusion that the citizens of this nation are enjoying unprecedented wealth and leisure, as shown especially by the figures for pleasure automobiles. (See Table 31.) Both conclusions are justified. It is interesting to speculate as to whether or not this immense amount of transportation equipment will not work toward a relocation of manufacturing industries with respect to markets and raw materials.

A better comparison of "form utility" equipment with "place utility" equipment, however, may be obtained if the horsepower of pleasure automobiles is subtracted from the "transportation" group, which will then include only equipment that is mostly "productive"—that is, equipment that transports raw materials and finished products or carries people engaged in production. If the figures thus obtained are compared with those for "manufactures and materials," they will still show a much more rapid rate of increase. Moreover, after 1919, "transportation" minus pleasure automobiles appreciably exceeds "manufactures and materials" even in absolute amount of equipment.

Table 7 presents statistics of population and wage earners for the country as a whole and for those fields of activity for which it was possible to obtain data. Figures 8, 9, and 10 compare the index numbers of population and wage earners with index numbers of horsepower equipment. It is evident that both before and after 1899 the amount of power equipment has increased more rapidly than the number of wage earners. This means that for each inhabitant and worker every successive decade has witnessed a larger installation of power.

There is another, more direct way of arriving at this conclusion. By dividing the capacity of prime movers by the number of wage earners, the amount of horsepower per wage earner may be obtained directly for each census year and index numbers constructed therefrom. This is done in Table 8 and portrayed graphically in Figure 11.[27]

The amount of equipment at the command of each inhabitant and wage earner in the country and in the several fields of activity has increased steadily. The absolute amount in any field of course depends on the expenditure of effort required to produce a given result; a larger installation per wage earner would be expected in the field of steam railroads than in the field of manufactures.

---

[27] Estimates of horsepower equipment by fields and horsepower equipment per wage earner are available from other sources. F. R. Low (Mechanical Engineering, January, 1925, p. 2) gives the following figures for installed capacity in horsepower in 1924:

| | |
|---|---|
| Central stations and industrial | 45,000,000 |
| Electric railways | 4,119,000 |
| Mining | 5,147,000 |
| Stationary (nonindustrial) | 4,000,000 |
| Steam railroads | 130,000,000 |
| Navigation | 16,000,000 |
| Agriculture and traction | 200,000,000 |
| Automotive | 300,000,000 |
| | 704,266,000 |

"If these figures are correct, there is installed for each unit of our population prime-mover capacity capable of generating about 7 horsepower."

W. L. De Baufre (Science, Oct. 30, 1925, p. 182) says: "The total of these figures [for 1919] is over 500,000,000 horsepower available for a population of 105,000,000 people, or about 5 horsepower for each man, woman, and child."

In the present study the 1919 total is 396,000,000 horsepower, and the horsepower per inhabitant 3.75.

The important generalization that proceeds from a study of Table 8 is that human effort is continually being supplanted by machinery and mechanical devices operated by prime movers. The work that man has to do is being performed more and more by the machine which he makes.

Tables 9 to 20 present figures of horsepower equipment for States and geographic districts. The study of power in this manner is profitable in a number of respects. It may not tell anything particularly new about a section of the country, but it should serve to reinforce what is already known. For any one decade it will indicate the part of the country to which a certain field of activity, such as agriculture, is chiefly confined. It will also show any changes that have occurred from decade to decade. As far as possible, it will do the same thing for types of equipment. Not only are actual amounts of power shown for each State, but for 1923, in order to offset any advantages or disadvantages resulting from differences in size of States, the amount of horsepower per square mile for the total amount of primary power, for horsepower in manufactures, and for horsepower in agriculture is given by States in Table 10. Power in such States as Rhode Island, Massachusetts, and Texas is thus shown in its true light as to "density" of use.

## SOME USES FOR THE POWER INDEX

Certain conspicuous trends appear from the foregoing analysis. Power as a whole has increased tremendously from 1849 to 1923. Among the activities using power, manufactures and transportation have increased in relative importance while agriculture has decreased. The capacity of prime movers used to generate electric power has advanced with enormous strides since the beginning of the present century. In general, during the period of 75 years the country has changed from one that was predominantly agricultural to one whose chief interests are industrial. More detailed surveys of the types of prime movers and of the amounts of power installed in States and geographic districts serve to substantiate these chief conclusions. Furthermore, the amount of horsepower equipment has grown at a more rapid pace than the number of wage earners. In other words, the number of horsepower units installed per worker in the country has steadily increased.

Thus, as the capacity of prime movers may be considered an index of the use of machinery in production, it must be concluded that human labor is continually being supplemented by mechanical devices. It is important, however, in any consideration of this notable trend, to bear in mind one especially significant qualification. The statistics in this study portray the rated capacity of prime movers—that is, they indicate the amount of equipment which is

available for use for 24 hours of every day, but they throw no light on the question concerning how much of the time this equipment is actually used in production. They are a record of what can be done, not of what really is done. This is a very important distinction. It is obvious that if all the primary power of manufacturing plants and mines and farms and railroads were operated to capacity every hour of every day, the resulting volume of production would dwarf any past achievements. But the fact that it is not and in the nature of things never could be so operated must be considered in any study of power equipment.

The relation that exists between capacity and actual use of prime movers is expressed by the figure called "capacity factor" or "use factor," which is the ratio of the actual output of power to that which would be produced if the prime mover were operated at full capacity during the entire period under consideration. For example, if a 20-horsepower steam engine is operated at full capacity 2,000 hours during a year, its output would be 40,000 horsepower-hours. If it were operated at full capacity the entire year, or 8,760 hours, the output would be 175,200 horsepower-hours. The ratio between the actual output and the output that could have been produced is the use or capacity factor—in this case 22.8 per cent. This ratio must not be confused with "load factor," which is a somewhat different ratio. The "load factor" is the ratio between the average load and the peak load of a given capacity of prime movers—that is, between the average of all demands and the greatest or highest demand made on the equipment. It is evident that the load factor may be and usually is larger than the use factor, for the peak load may not tax the prime movers to their full capacity.

It is desirable to obtain some idea regarding the use factors of equipment in the different fields of activity that have been the subjects of consideration in this study. In manufactures one authority gives the use factor as about 13.7 per cent.[28] Data from another source [29] provide the basis for the calculation of the average use factor for manufactures, mines and quarries, and Government institutions as about 20 per cent. In mines and quarries it has variously been estimated from about 14.3 per cent for all mines to 24 per cent for anthracite mines and 12 per cent for all other mines and quarries.[30]

The lowest use factor among all activities but automobiles is found in agriculture. "The necessity of keeping a large primary power plant available to take care of the occasional peak loads that occur

[28] Kinsman, C. D., An appraisal of power used on farms: U. S. Dept. Agr. Bull. 1438, p. 4, 1925. Based on 1919 census.

[29] Murray, W. S., and others, A superpower system for the region between Boston and Washington: U. S. Geol. Survey Prof. Paper 123, Table 48, following p. 141, 1921. Based on 1919 census. The region considered is large enough to be representative of the entire country.

[30] The first is Kinsman's estimate. The other two are based on the superpower report, in which it was impossible to combine the two groups.

in most types of farming results in an average load factor of only about 4 per cent." [31] Power equipment on farms is idle most of the time. This disadvantage is of course inherent in the nature of the work to be performed on farms.

In the field of electric central stations the use factor is much higher. In 1922 it was 30.9 per cent, while that of electric railroads was 24.0 per cent.[32] Central-station power is called upon by its consumers, industrial or general public, more frequently and more steadily. This more even demand and the diversity of the activities supplied by central stations explain why prime movers of this activity have relatively high use factors.

Only one estimate is available regarding the use factor of railroad equipment.[33] The figure, 6.8 per cent, is much lower than that given for electric railroads. This low use factor is due to the intermittent use of steam locomotives and to the necessity for frequent inspections and repairs.

Another item of "heavy" transportation, however, was found to be much more frequently used. In general, it may be said that ships are engaged in productive work about 50 per cent of the time.[34] This is a general average: many types of vessels have a use factor as high as 70 per cent, and others may be employed only 30 per cent of the time. Much depends on the type of vessel, the rates of chartering, the ports of destination, and a number of other elements.

The use factor of automobiles is said to be about 3 per cent.[35] This low use factor should be kept in mind in comparing the total horsepower of automobiles with the total horsepower of prime movers in other activities. The accuracy of the estimate is questionable, but it is certain that pleasure automobiles are used but a very small fraction of the time throughout a year, and 3 per cent is probably very close to the true figure, especially as the actual or brake horsepower is used as the capacity of automobile engines. (See p. 75.) Trucks engaged in productive carriage doubtless have a much higher use factor.

This general concept of the use factor should be taken into account in any presentation of the results and benefits of increased power installation. Low,[36] after pointing out that every inhabitant in this country has at present at his command the equivalent in power of

---

[31] Kinsman, C. D., op. cit., p. 43. Other data given in this study show the use factor also to be about 4 per cent.

[32] Census of electrical industries, 1922, pp. 8, 66.

[33] Kinsman, C. D., op. cit., p. 4.

[34] This ratio was obtained by writing to all the important passenger lines and to the research bureau of the United States Shipping Board.

[35] The National Automobile Chamber of Commerce has made an effort to get annual mileage figures for automobiles. As a whole the replies have averaged about 6,000 miles. Truck mileage may be double this. But the returns are not large enough to serve as the basis for a nation-wide estimate. The use factor could of course be obtained by dividing 6,000 by a possible yearly mileage, but it is out of the question to think of obtaining the factor by the same method which is applied in other fields.

[36] Low, F. R., Mechanical Engineering, January, 1925, p. 2.

nearly 150 slaves, says: "That is what we could have if we had to, with the power-producing machinery already at our service; but it is not running all the time or at full load when it does run. Mills run only 40-odd hours a week; the load factor of most central stations is less than 40 per cent. * * * It is impossible, therefore, to tell how hard our mechanical slaves are working or how many horsepower-hours of actual service are actually produced by them per year."

It is important to note also that over a period of years the capacity factor for a certain field or for a certain industry may change—that is, the installed equipment may be used to a greater or less extent. It is entirely possible for capacity to increase and for actual use to decrease at the same time. This is an element worthy of consideration when an index of power equipment is compared with an index of volume of production. If the former outstrips the latter the reason may be partly that the use factor has decreased over the period. In almost all manufacturing industries some of the equipment included in the census is used only during times of exceptional business activity. For example, there are many blast furnaces of antiquated type in the country, which were used only during the recent war. Similarly there are many cotton spindles and flour-milling machines which have been idle for some time; but the engines which drive them have been included in the census. Mere horsepower capacity in itself, then, falls short of presenting a complete picture of the actual conditions in any field and at any one time.

The purpose of this study is primarily to set forth the trends manifested in horsepower equipment, but in conclusion it may not be out of place to suggest a number of ways in which the power index may be employed. They may be enumerated as follows:

1. As a measure of general industrial growth.
2. As a measure of capital accumulation.
3. As a measure of mechanical development, by comparing the index of power equipment with indices or measures of (*a*) the supply of labor (or number of wage earners); (*b*) the volume of production; (*c*) the volume of production per wage earner; (*d*) the area of agricultural land in use; (*e*) the amount of wages per wage earner; (*f*) the capital invested per wage earner.
4. As a means of comparing these items for the United States as a whole with those for other countries and with those for individual States or districts of this country.

Three of these uses have been developed in the preceding pages. Frequent reference has been made to the one which heads the list. The same is true for the second one, if "capital" is taken to mean instruments of production, particularly machinery. It is recognized, of course, that the power index tells nothing about the degree of intricacy or the value of the machines and their products. For example, a dentist's machine uses much less power in relation to the

value of the machine than a textile-weaving machine. The growth in power equipment has also been compared with the growth in population and in number of wage earners and found to have advanced much more rapidly—in other words, the amount of horsepower per wage earner has shown a steady and decided rise since 1849.

The increase in equipment may also be compared with the increase in volume of production. This is perhaps the chief use of the power index and certainly its chief claim to interest in the minds of contemporary business men and economists. The articles already cited and quoted are indicative of the present concern over this subject. In addition, the National Industrial Conference Board, which has made an extensive survey of power in manufactures, has released several press notices in which it stresses the increased productivity of labor and offers as the cause thereof the rapid growth of horsepower equipment. If the volume of output has grown faster than the number of wage earners, the inference safely follows that production per wage earner has increased throughout the period. And if, at the same time, the amount of power equipment has increased, it may be assumed that this item, so closely associated with human labor in production, has been at least partly responsible for the increase in output. A still better way of getting at this correlation is to compare directly the growth in power per wage earner with growth in volume of production per wage earner, as suggested on page 39. If both have increased together, it is safe to assume that a correlation exists—that the growth in power is to be largely credited with the growth in production.

It is realized that other elements may also enter into the matter of increased output. The wider employment of approved management methods, the campaign against waste, improved organization, and better industrial relations have all undoubtedly helped to effect the general result. But these elements were used in conjunction with more and better mechanical equipment.

The use of the power index in this connection is so significant that space may well be taken in illustrating it. Table 21 presents a summary of special items for comparison. These items have been selected because index numbers of volume of production are available for them. W. W. Stewart [37] has presented indices of production for "manufactures," "materials," "transportation," "mines and quarries," "agriculture," and the sum of these five from 1889 to 1919. The index numbers of "manufactures" are based upon 50 commodities. Those for "materials" are based upon 39 of the products of mines and agriculture. The indices of "transportation" are derived from a consideration of two factors on steam railroads—ton-miles of freight and passenger-miles. The "materials" group is subdivided into "mines

[37] Am. Econ. Review, March, 1920, p. 57.

and quarries" and "agriculture." Finally the sum of "manufactures," "materials," and "transportation" is expressed in the item "all commodities," made up of the total of 91 products. The index numbers do not merely represent production for the years indicated. They are five-year averages, thus giving consideration to the two years before and the two years after 1889, 1899, and 1909. It was impossible to take more than a three-year average for 1919, as Stewart's figures ended with that year.

The index numbers follow this classification in Table 21, which shows amount of equipment, number of wage earners, and volume of production and also makes the more direct comparison between horsepower per wage earner and production per wage earner. Figure 34 pictures the relative rates of growth graphically.

The table shows that in almost every group, from 1889 to 1919, horsepower equipment registered the fastest growth. Volume of production is next, and number of wage earners third. This record points clearly to only one conclusion—volume of production per wage earner has grown steadily, accompanied by an even greater increase in power. The fact that in all items except "mines and quarries" power has grown much faster than volume of production, however, might seem to indicate a condition of diminishing returns—that is, volume of production has increased with the growth of power, but not in as great a proportion. Plausible as this inference seems the fact must not be forgotten that the power index merely shows capacity, not actual use. It might be that a decrease in rapidity of growth of actual use of power would be shown if it were possible to ascertain the figures. It is possible even that in certain items use of power might be outstripped by volume of production.

The indices showing volume of production per wage earner are obtained by dividing the indices of volume of production by the indices of number of wage earners. They show even more plainly the continuous increase in the productivity of labor. But when compared with installed horsepower per wage earner the volume of production per wage earner is seen to have risen less rapidly, especially since 1899. Before that year productivity led in none of the items except "manufactures" and "mines and quarries." Once more the fact that only capacity of prime movers is being considered precludes any conclusions concerning diminishing returns, but it seems fairly evident that increasing returns may have existed before 1899 in all but the two items noted. After that year only two of the indices, both for "mines and quarries," show a similar state of affairs; in 1909 the index of productivity exceeds the index of power by 14 per cent and in 1919 by 11 per cent. This increase may show the influence of the new cutting machinery in mines.

There seems, then, to be a marked correlation between productivity and power. This relation may be determined with a much greater degree of exactitude when more accurate and fuller information concerning power equipment and volume of production becomes available. One obvious weakness of index numbers of production extending backward a score or more of years is their failure to take into consideration the tremendous improvement in utility of the unit considered. It is plain that an automobile of 1909 or even of 1919 is not the equal in utility of an automobile of 1923, and similar comparisons may be made with reference to the units of other commodities. This means that the increase in productivity portrayed in Table 21 falls short of measuring the actual increase in total utility of the immense volume of goods that is poured forth year after year. The curve of total utility would rise even more sharply.

The power index also admits of comparison with an index showing the increase in amount of improved farm land. This comparison would emphasize the growth of the United States as a manufacturing country and bring out the relative retrogression of agriculture. It is made in Table 22. From 1849 to 1919 the acreage of improved land increased only four and one-half times, while the power capacity increased more than seventeen times.

A basis is thus furnished for a little excursion into the field of economic theory. Those who embrace the classical theory of marginal productivity will see in the development of horsepower equipment the growth of instrumental capital at a pace much more rapid than that shown by labor and by land. They will find, then, that the marginal productivity of labor and land has increased relatively to that of capital, with resultant high wages per man and high rents to the landowner. Furthermore, the absolute amount of instrumental capital is so great that it takes a large absolute share of the product of industry.

Two other interesting uses of the power index for comparison are thus suggested. It may be compared with the growth in amount of wages per wage earner and with the amount of capital invested per wage earner.

The most inviting use to which the index of horsepower equipment in the United States could be put seems to be a comparison with indices based on similar studies made in other countries, such as Germany, France, and England. Europe is immensely interested in and perhaps apprehensive of the unprecedented prosperity of this country. It would be extremely interesting to see if the greater volume of production and higher wages in the United States coincide with a correspondingly greater amount and growth of horsepower equipment than can be found in the Old World.

## BIBLIOGRAPHY

### TECHNICAL

#### GENERAL PAPERS

Bishop, G. L., History of American manufactures from 1608 to 1860. Philadelphia, Young, 1861, 1864.
Clark, V. S., History of manufactures in the United States, 1607 to 1860. Carnegie Inst. Washington Pub. 215 b, 1916.
Kaempffert, Waldemar, A popular history of invention. New York, Scribner's, 1924.
Kennedy, Rankin, Modern engines and power generators. New York, Van Nostrand, 1904.
Lauer, C. N., Engineering in American industry. New York, McGraw-Hill, 1924.
Lucke, C. E., Power. New York, Columbia Univ. Press, 1911.
Morse, F. L., Power, its application from the seventeenth to the twentieth century. Ithaca, Morse Chain Co., 1923.
Tryon, R. M., Household manufactures in the United States. Univ. Chicago Press, 1917.
First World Power Conference Trans., 4 vols. London, Lund Humphries, 1924.

#### STEAM POWER

Benjamin, C. H., The steam engine. Brattleboro, Vt., 1909.
Croft, Terrel, Steam boilers. New York, McGraw-Hill, 1921.
Neilson, R. M., The steam turbine. London, Longmans, 1902.
Peabody, C. H., Thermodynamics of the s eam turbine. New York, John Wiley & Sons, 1911.
Powles, H. H. P., Steam boilers, their history and development. Philadelphia, J. B. Lippincott, 1905.
Shealy, E. M., Steam engines. New York, McGraw-Hill, 1921.
Stretton, C. E., The locomotive engine and its development. New York, Van Nostrand, 1910.
Thurston, Robert, The history of the growth of the steam engine. New York, Appleton, 1878.

#### INTERNAL-COMBUSTION POWER

Hirshfield, C. F., and Ulbrecht, T. C., Gas power. New York, John Wiley & Sons, 1913.
Hogle, W. H., Internal-combustion engines. New York, McGraw, 1909.
Gunge, F. E., Gas power. New York, Hill, 1908.

#### WATER POWER

Greene, A. M., Pumping machinery. New York, John Wiley & Sons, 1911.
Mead, D. W., Water-power engineering. New York, McGraw, 1908.

#### ELECTRICITY

Bell, Louis, Electric power transmission. New York Elec. World and Engineer, 1899.
Crocker, F. B., and Arendt, Morton, Electric motors. New York, Van Nostrand, 1914.
Sheldon, Samuel, Dynamo electric machinery. New York, Van Nostrand, 1910.

## STATISTICAL

### MANUFACTURES

Bishop, G. L., History of American manufactures from 1608 to 1860. Philadelphia, Young, 1861–1864.
Censuses, 1850–1923.
Clark, V. S., History of manufactures in the United States. Carnegie Inst. Washington Pub. 215 b, 1916.
National Industrial Conference Board, A graphic analysis of the census of manufactures, 1923.

### MINES AND QUARRIES

Censuses, 1850–1923.

### AGRICULTURE AND WORK ANIMALS NOT ON FARMS

Censuses, 1850–1923.
Kinsman, C. D., An appraisal of power used on farms in the United States. U. S. Dept. Agr. Bull. 1438, 1925.

### IRRIGATION AND DRAINAGE

Censuses, 1910 and 1920.

### ELECTRIC CENTRAL STATIONS AND ELECTRIC RAILROADS

Censuses, 1902–1922.
Baum, F. G., Atlas of U. S. A. power industry. New York, McGraw-Hill, 1923.
Electrical World, Annual progress and statistical issue, Jan. 2, 1926.

### STEAM RAILROADS

Interstate Commerce Commission, statistical reports, 1888–1924.
Poor's Manual of Railroads.

### SHIPS

Commissioner of Navigation, Annual statistical reports, 1880–1924, and Merchant marine statistics, 1924.

### AUTOMOBILES

Facts and figures of the automobile industry, National Automobile Chamber of Commerce, 1923–1926.
Motor, issues of January 1, 1905–1924.

## GENERAL

Engel, Ernst, Zeitalter des Dampfes. Berlin, 1880.
Fairgreve, James, Geography and world power. Univ. London, 1921.
Gilbert, C. G., and Pogue, J. E., America's power resources. New York, Century Co., 1921.
Polakov, W. N., Mastering power production. New York, Engineering Magazine Co., 1921.
Mulhall, M. G., Dictionary of statistics. London, G. Routledge & Sons, 1892.
Murray, W. S., Superpower, its genesis and future. New York, McGraw-Hill, 1925.
Associated Industries of Massachusetts, report of its power investigating committee, Boston, April, 1924.

## ARTICLES IN PERIODICALS

De Baufre, W. L., Mechanical power. Science, vol. 62, Oct. 30, 1925.
Ely, S. B., and Rittman, W. V., Prosperity and power. Sci. Monthly, June, 1925.
Gompers, Samuel, Power and labor. Survey, Mar. 1, 1924.
Hart, J. K., Power and culture. Survey, Mar. 1, 1924.
Hoover, Herbert, The Nation's Business, June 5, 1926.
Low, Fred, Mechanical Engineering, January, 1925.
Smith, G. O., How will man's work be done? Collier's, Mar. 14, 1925.
You have thirty slaves. Independent, June 21, 1919.

## TABLES

TABLE 1.—*Total horsepower of prime movers [a] in the United States, 1849–1923*

**Total**

| Year | Horsepower | Index No. (1899=100) |
|---|---|---|
| 1849 | [b] 10,066,000 | 16 |
| 1859 | [b] 15,793,000 | 25 |
| 1869 | 19,147,000 | 30 |
| 1879 | 28,820,000 | 45 |
| 1889 | 47,697,000 | 74 |
| 1899 | 64,193,000 | 100 |
| 1909 | 120,331,000 | 187 |
| 1919 | 396,118,000 | 617 |
| 1923 | 684,044,000 | 1066 |

**Exclusive of pleasure automobiles**

| | | |
|---|---|---|
| 1899 | 64,161,000 | 100 |
| 1909 | 112,873,000 | 176 |
| 1919 | 176,650,000 | 275 |
| 1923 | 230,514,000 | 359 |

[a] Work animals are considered to be prime movers and therefore are included in the totals in this table and in columns "Agriculture" and "Work animals not on farms" of Table 2.
[b] Data for first two decades very incomplete and almost wholly estimated.

TABLE 2.—*Horsepower of prime movers installed in different activities, 1849–1923* [a]

**Horsepower (thousands)**

| Year | Manufactures [b] | Mines and quarries [c] | Agriculture [d] | Irrigation and drainage [e] | Electric central stations [f] | Electric railroads [g] | Steam railroads [h] | Ships [i] | Automobiles [j] | Work animals not on farms [k] | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | 1,100 | 50 | 6,597 | ---- | ---- | ---- | 435 | 734 | ---- | 1,150 | 10,066 |
| 1859 | 1,600 | 150 | 9,655 | ---- | ---- | ---- | 1,940 | 1,142 | ---- | 1,306 | 15,793 |
| 1869 | 2,346 | 350 | 9,588 | ---- | ---- | ---- | 4,100 | 1,076 | ---- | 1,687 | 19,147 |
| 1879 | 3,411 | 650 | 13,764 | 5 | ---- | ---- | 7,720 | 1,110 | ---- | 2,160 | 28,820 |
| 1889 | 5,850 | 1,300 | 19,835 | 33 | 120 | 140 | 16,300 | 1,444 | ---- | 2,675 | 47,697 |
| 1899 | 9,778 | 2,754 | 23,519 | 120 | 1,200 | 935 | 20,900 | 1,900 | 32 | 3,055 | 64,193 |
| 1909 | 16,803 | 4,403 | 30,807 | 361 | 5,225 | 3,091 | 45,400 | 3,122 | 7,714 | 3,405 | 120,331 |
| 1919 | 20,063 | 5,112 | 39,222 | 816 | 15,250 | 4,360 | 72,300 | 6,584 | 230,432 | 1,979 | 396,118 |
| 1923 | 19,728 | 5,000 | 38,100 | 1,300 | 22,000 | 4,100 | 74,600 | 10,262 | 507,254 | 1,700 | 684,044 |

**Horsepower, exclusive of pleasure automobiles (thousands)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1899 | 9,778 | 2,754 | 23,519 | 120 | 1,200 | 935 | 20,900 | 1,900 | 0 | 3,055 | 64,161 |
| 1909 | 16,803 | 4,403 | 30,807 | 361 | 5,225 | 3,091 | 45,400 | 3,122 | 256 | 3,405 | 112,873 |
| 1919 | 20,063 | 5,112 | 39,222 | 816 | 15,250 | 4,360 | 72,300 | 6,584 | 10,964 | 1,979 | 176,650 |
| 1923 | 19,728 | 5,000 | 38,100 | 1,300 | 22,000 | 4,100 | 74,600 | 10,262 | 53,724 | 1,700 | 230,514 |

[a] No duplication in this table.
[b] Data for all years except 1849 and 1859 from census reports; estimated for these years on basis of number of wage earners and by extrapolation.
[c] Data from census reports, except for 1849, 1859, 1869, 1879, and 1889; estimated for these years from scattered census sources.
[d] Data from study of C. D. Kinsman, agricultural engineer (An appraisal of power on farms in the United States: U. S. Dept. Agr. Bull. 1348, 1925). Includes work animals.
[e] Data from census reports, except for 1879, 1889, and 1899; estimated for these years on basis of acreage.
[f] Special census reports give data for 1902, 1907, 1912, 1917, and 1922. Data for 1889 and 1899 estimated on basis of historical facts in these reports and carried back by extrapolation. Data for 1909 and 1919 estimated from neighboring years by interpolation, for 1923 by extrapolation.
[g] Same sources and methods as for electric central stations.
[h] Estimated from 1899 to 1923 on basis of pounds of tractive force reported by Interstate Commerce Commission. For previous years, estimated on basis of track mileage. See Table 29.
[i] Estimated from tonnage of vessels. See Table 30.
[j] Estimated from registration figures to which horsepower figures were applied. See Table 33.
[k] From Kinsman's figures.

TABLE 2.—*Horsepower of prime movers installed in different activities, 1849–1923*—Continued

**Percentage of each year's total**

| Year | Manufactures | Mines and quarries | Agriculture | Irrigation and drainage | Electric central stations | Electric railroads | Steam railroads | Ships | Automobiles | Work animals not on farms | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | 10.90 | 0.50 | 65.52 | | | | 4.30 | 7.30 | | 11.48 | 100.00 |
| 1859 | 10.12 | .94 | 61.18 | | | | 12.26 | 7.24 | | 8.26 | 100.00 |
| 1869 | 12.24 | 1.83 | 50.03 | | | | 21.37 | 5.72 | | 8.81 | 100.00 |
| 1879 | 11.82 | 2.26 | 47.77 | 0.02 | | | 26.81 | 3.86 | | 7.46 | 100.00 |
| 1889 | 12.24 | 2.73 | 41.60 | .07 | 0.25 | 0.29 | 34.19 | 3.03 | | 5.60 | 100.00 |
| 1899 | 15.23 | 4.28 | 36.63 | .19 | 1.87 | 1.46 | 32.57 | 2.96 | 0.05 | 4.76 | 100.00 |
| 1909 | 13.98 | 3.66 | 25.62 | .30 | 4.33 | 2.57 | 37.73 | 2.59 | 6.41 | 2.83 | 100.00 |
| 1919 | 5.05 | 1.29 | 9.90 | .21 | 3.85 | 1.10 | 18.25 | 1.66 | 58.20 | .49 | 100.00 |
| 1923 | 2.89 | .73 | 5.57 | .19 | 3.22 | .60 | 10.91 | 1.50 | 74.14 | .25 | 100.00 |

**Percentage, exclusive of pleasure automobiles**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1899 | 15.24 | 4.29 | 36.66 | 0.19 | 1.87 | 1.46 | 32.57 | 2.96 | 0 | 4.76 | 100.00 |
| 1909 | 14.89 | 3.90 | 27.29 | .32 | 4.63 | 2.73 | 40.22 | 2.77 | .23 | 3.02 | 100.00 |
| 1919 | 11.32 | 2.88 | 22.23 | .46 | 8.63 | 2.47 | 40.92 | 3.76 | 6.21 | 1.12 | 100.00 |
| 1923 | 8.57 | 2.17 | 16.51 | .57 | 9.55 | 1.78 | 32.34 | 4.46 | 23.31 | .74 | 100.00 |

**Index numbers (1899=100)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | 11 | 2 | 28 | | | | 2 | 39 | | 38 | 16 |
| 1859 | 16 | 5 | 41 | | | | 9 | 60 | | 43 | 25 |
| 1869 | 24 | 13 | 41 | | | | 20 | 57 | | 55 | 30 |
| 1879 | 36 | 24 | 59 | 4 | | | 37 | 58 | | 71 | 45 |
| 1889 | 60 | 47 | 84 | 28 | 10 | 15 | 78 | 76 | | 88 | 74 |
| 1899 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1909 | 172 | 160 | 131 | 301 | 435 | 330 | 217 | 164 | 24,106 | 111 | 187 |
| 1919 | 205 | 186 | 167 | 680 | 1,271 | 466 | 346 | 347 | 720,100 | 65 | 617 |
| 1923 | 202 | 182 | 162 | 1,083 | 1,832 | 438 | 357 | 540 | 1,585,169 | 56 | 1,065 |

**Index numbers, exclusive of pleasure automobiles**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1899 | | | | | | | | | | | 100 |
| 1909 | | | | | | | | | 100 | | 176 |
| 1919 | | | | | | | | | 4,283 | | 275 |
| 1923 | | | | | | | | | 20,986 | | 359 |

TABLE 3.—*Horsepower utilized in each field of activity, 1849–1923* [a]

**Horsepower (thousands)**

| Year | Manufactures | Mines and quarries | Agriculture | Irrigation and drainage | Electric central stations | Electric railroads | Steam railroads | Ships | Automobiles | Work animals not on farms | Total | Total exclusive of pleasure automobiles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | 1,100 | 50 | 6,597 | ------ | ------ | ------ | 435 | 734 | ------ | 1,150 | 10,066 | 10,066 |
| 1859 | 1,600 | 150 | 9,655 | ------ | ------ | ------ | 1,940 | 1,142 | ------ | 1,306 | 15,793 | 15,793 |
| 1869 | 2,346 | 350 | 9,588 | ------ | ------ | ------ | 4,100 | 1,076 | ------ | 1,687 | 19,147 | 19,147 |
| 1879 | 3,411 | 650 | 13,764 | 5 | ------ | ------ | 7,720 | 1,110 | ------ | 2,160 | 28,820 | 28,820 |
| 1889 | 5,939 | 1,300 | 19,835 | 33 | 120 | 140 | 16,300 | 1,444 | ------ | 2,675 | 47,786 | 47,786 |
| 1899 | 10,098 | 2,868 | 23,519 | 120 | 1,200 | 1,079 | 20,900 | 1,900 | 32 | 3,055 | 64,771 | 64,739 |
| 1909 | 18,675 | 4,608 | 31,107 | 361 | 5,225 | 3,718 | 45,400 | 3,122 | 7,714 | 3,405 | 123,335 | 116,877 |
| 1919 | 29,505 | 6,724 | 43,722 | 816 | 15,250 | 6,327 | 72,300 | 6,584 | 230,432 | 1,979 | 413,639 | 194,171 |
| 1923 | 33,094 | 7,500 | 47,420 | 1,300 | 22,000 | 6,784 | 74,600 | 10,262 | 507,254 | 1,700 | 711,914 | 258,384 |

**Index numbers (1899=100)**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | 11 | 2 | 28 | ------ | ------ | ------ | 2 | 39 | ------ | 38 | 16 | 16 |
| 1859 | 16 | 5 | 41 | ------ | ------ | ------ | 9 | 60 | ------ | 43 | 24 | 24 |
| 1869 | 23 | 12 | 41 | ------ | ------ | ------ | 20 | 57 | ------ | 55 | 30 | 30 |
| 1879 | 34 | 23 | 59 | 4 | ------ | ------ | 37 | 58 | ------ | 71 | 44 | 44 |
| 1889 | 59 | 45 | 84 | 27 | 10 | 13 | 78 | 76 | ------ | 88 | 74 | 74 |
| 1899 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1909 | 185 | 161 | 132 | 301 | 435 | 345 | 217 | 164 | 24,100 | 111 | 190 | 181 |
| 1919 | 292 | 234 | 186 | 680 | 1,271 | 586 | 346 | 347 | 720,100 | 65 | 639 | 300 |
| 1923 | 328 | 262 | 202 | 1,083 | 1,832 | 629 | 357 | 540 | 1,585,168 | 56 | 1,099 | 399 |

[a] Horsepower purchased or rented is counted in the field of activity using it and also where it is installed. Autotrucks are included under both "Agriculture" and "Automobiles." There is therefore some duplication in the figures in this table. The amount of duplication is indicated by the difference between the figures for the corresponding activities in Tables 2 and 3. For sources of data see Table 2.

61750—28——4

TABLE 4.—*Horsepower of prime movers, 1849–1923, by types* [illegible] *prime movers*

**Total**

| Year | A. Horsepower (thousands) | | | | | | B. Percentage of each year's total | | | | | C. Index numbers (1899=100) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Steam engines and turbines | Internal-combustion engines [a] | Water wheels | Windmills | Work animals [b] | Total | Steam engines and turbines | Internal-combustion engines | Water wheels | Windmills | Work animals | Steam engines and turbines | Internal-combustion engines | Water wheels | Windmills | Work animals |
| 1849 | [c] 1,228 | ------- | [c] 662 | 429 | 7,747 | 10,066 | 12.19 | ------- | 6.58 | 4.26 | 76.97 | 3 | ------- | 36 | 65 | 35 |
| 1859 | [c] 3,263 | ------- | [c] 930 | 639 | 10,961 | 15,793 | 20.66 | ------- | 5.88 | 4.05 | 69.41 | 8 | ------- | 50 | 97 | 49 |
| 1869 | [a] 6,215 | ------- | [a] 1,205 | 452 | 11,275 | 19,147 | 32.51 | ------- | 6.21 | 2.36 | 58.92 | 16 | ------- | 65 | 69 | 50 |
| 1879 | [a] 11,636 | ------- | [a] 1,353 | 507 | 15,324 | 28,820 | 40.38 | ------- | 4.69 | 1.76 | 53.17 | 30 | ------- | 73 | 77 | 69 |
| 1889 | [a] 24,281 | 17 | [a] 1,522 | 566 | 21,311 | 47,697 | 50.89 | 0.03 | 3.20 | 1.19 | 44.69 | 63 | 2 | 82 | 86 | 96 |
| 1899 | [a] 38,445 | 956 | [a] 1,860 | 658 | 22,274 | 64,193 | 59.84 | 1.49 | 2.90 | 1.02 | 34.75 | 100 | 100 | 100 | 100 | 100 |
| 1909 | 77,055 | 13,170 | 4,022 | 822 | 25,262 | 120,331 | 63.99 | 10.94 | 3.34 | .68 | 21.05 | 200 | 1,378 | 216 | 125 | 113 |
| 1919 | 116,380 | 247,031 | 7,650 | 836 | 24,221 | 396,118 | 29.43 | 62.32 | 1.92 | .21 | 6.13 | 303 | 25,840 | 411 | 127 | 109 |
| 1923 | 125,773 | 526,322 | 9,598 | 851 | 21,500 | 684,044 | 18.33 | 77.00 | 1.41 | .12 | 3.14 | 327 | 55,055 | 516 | 129 | 97 |
| **Exclusive of pleasure automobiles** | | | | | | | | | | | | | | | | |
| 1899 | [a] 38,445 | 924 | [a] 1,860 | 658 | 22,274 | 64,161 | 59.87 | 1.44 | 2.90 | 1.02 | 34.77 | 100 | 100 | 100 | 100 | 100 |
| 1909 | 77,055 | 5,712 | 4,022 | 822 | 25,262 | 112,873 | 68.26 | 5.07 | 3.57 | .73 | 22.37 | 200 | 618 | 216 | 125 | 113 |
| 1919 | 116,380 | 27,563 | 7,650 | 836 | 24,221 | 176,650 | 66.00 | 15.56 | 4.33 | .47 | 13.64 | 303 | 2,983 | 411 | 127 | 109 |
| 1923 | 125,773 | 72,792 | 9,598 | 851 | 21,500 | 230,514 | 54.57 | 31.57 | 4.16 | .37 | 9.33 | 327 | 7,878 | 516 | 129 | 97 |

[a] Estimated or calculated in part.
[b] Data furnished by C. D. Kinsman, U. S. Department of Agriculture.
[c] Estimated.

TABLE 5.—*Horsepower of prime movers utilized, 1849–1923, by types of prime movers and fields of activity*

**Manufactures**

| Year | Horsepower (thousands) | | | | | | Percentage of each year's total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Steam engines and turbines | Internal-combustion engines | Water wheels | Operated by purchased power | | Total | Steam engines and turbines | Internal-combustion engines | Water wheels | Operated by purchased power | |
| | | | | Electric motors | Other equipment | | | | | Electric motors | Other equipment |
| 1849 | [a] 450 | ---- | [a] 650 | ---- | ---- | 1,100 | 41.00 | ---- | 59.00 | ---- | ---- |
| 1859 | [a] 700 | ---- | [a] 900 | ---- | ---- | 1,600 | 43.70 | ---- | 56.30 | ---- | ---- |
| 1869 | 1,216 | ---- | 1,130 | ---- | ---- | 2,346 | 51.80 | ---- | 48.20 | ---- | ---- |
| 1879 | 2,185 | ---- | 1,225 | ---- | ---- | 3,410 | 64.10 | ---- | 35.90 | ---- | ---- |
| 1889 | 4,586 | 9 | 1,255 | ---- | 89 | 5,939 | 77.23 | 0.15 | 21.13 | ---- | 1.49 |
| 1899 | 8,190 | 135 | 1,454 | 183 | 137 | 10,099 | 81.10 | 1.33 | 14.40 | 1.81 | 1.36 |
| 1909 | 14,229 | 751 | 1,823 | 1,749 | 124 | 18,676 | 76.19 | 4.02 | 9.76 | 9.37 | .66 |
| 1919 | 17,040 | 1,259 | 1,765 | 9,348 | 95 | 29,507 | 57.75 | 4.27 | 5.98 | 31.68 | .32 |
| 1923 | 16,701 | 1,224 | 1,803 | 13,365 | ---- | 33,093 | 50.47 | 3.71 | 5.45 | 40.37 | ---- |

**Mines and quarries**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | [a] 38 | ---- | [a] 12 | ---- | ---- | 50 | 77.00 | ---- | 23.00 | ---- | ---- |
| 1859 | [a] 120 | ---- | [a] 30 | ---- | ---- | 150 | 79.50 | ---- | 20.50 | ---- | ---- |
| 1869 | [a] 275 | ---- | [a] 75 | ---- | ---- | 350 | 79.00 | ---- | 21.00 | ---- | ---- |
| 1879 | [a] 525 | ---- | [a] 125 | ---- | ---- | 650 | 81.00 | ---- | 19.00 | ---- | ---- |
| 1889 | [a] 1,050 | ---- | [a] 250 | ---- | ---- | 1,300 | 81.00 | ---- | 19.00 | ---- | ---- |
| 1899 | 2,433 | 260 | 61 | 114 | ---- | 2,868 | 84.83 | 9.07 | 2.13 | 3.97 | ---- |
| 1909 | 3,787 | 519 | 97 | 206 | ---- | 4,609 | 82.20 | 11.20 | 2.10 | 4.50 | ---- |
| 1919 | 3,712 | 1,361 | 38 | 1,603 | 9 | 6,723 | 55.10 | 20.30 | .60 | 23.90 | 0.1 |
| 1923 | [a] 3,275 | [a] 1,700 | [a] 25 | 2,500 | ---- | 7,500 | 43.70 | 22.70 | .30 | 33.30 | ---- |

[a] Estimated.

TABLE 5.—*Horsepower of prime movers utilized, 1849–1923, by types of prime movers and fields of activity*—Continued

**Irrigation and drainage** [b]

| Year | Horsepower (thousands) | | | | | | Percentage of each year's total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Steam engines and turbines | Internal-combustion engines | Water wheels | Operated by purchased power | | Total | Steam engines and turbines | Internal-combustion engines | Water wheels | Operated by purchased power | |
| | | | | Electric motors | Other equipment | | | | | Electric motors | Other equipment |
| 1878 | 2.5 | | 2.5 | | | 5 | 50.0 | | 50.0 | | |
| 1889 | 8 | 8 | 16.5 | | | 32.5 | 24.6 | 24.6 | 50.8 | | |
| 1899 | 30 | 30 | 60 | | | 120 | 25.0 | 25.0 | 50.0 | | |
| 1909 | 90 | 90 | 181 | | | 361 | 24.9 | 24.9 | 50.2 | | |
| 1919 | 200 | 200 | 416 | | | 816 | 24.5 | 24.5 | 51.0 | | |
| 1923 | 300 | 300 | 700 | | | 1,300 | 23.0 | 23.0 | 54.0 | | |
| **Electric central stations** [c] | | | | | | | | | | | |
| 1889 | 120 | | | | | 120 | 100.0 | | | | |
| 1899 | 950 | | 250 | | | 1,200 | 79.0 | | 21.0 | | |
| 1909 | 3,450 | 75 | 1,700 | | | 5,225 | 66.0 | 1.4 | 32.6 | | |
| 1919 | 10,100 | 250 | 4,900 | | | 15,250 | 66.2 | 1.7 | 32.1 | | |
| 1923 | 15,000 | 350 | 6,650 | | | 22,000 | 68.2 | 1.6 | 30.2 | | |
| **Electric railroads** [c] | | | | | | | | | | | |
| 1889 | 140 | | | | | 140 | 100.0 | | | | |
| 1899 | 900 | | 35 | 144 | | 1,079 | 83.4 | | 3.2 | 13.4 | |
| 1909 | 2,850 | 21 | 220 | 627 | | 3,718 | 76.6 | 0.6 | 5.9 | 16.9 | |
| 1919 | 3,800 | 30 | 530 | 1,967 | | 6,327 | 60.0 | .5 | 8.4 | 31.1 | |
| 1923 | 3,650 | 30 | 420 | 2,684 | | 6,784 | 53.8 | .4 | 6.2 | 39.6 | |

[b] Segregation arbitrary. Data for 1879, 1889, 1899, and 1923 estimated on basis of acreage.
[c] All power in 1889 assumed to be steam engines. Estimated from census reports for other years.

**Agriculture** [4]

| Year | Horsepower (thousands) | | | | | | Percentage of each year's total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Steam engines and turbines | Internal-combustion engines | Windmills | Work animals | Operated by purchased power (electric motors) | Total | Steam engines and turbines | Internal-combustion engines | Windmills | Work animals | Operated by purchased power (electric motors) |
| 1849 | | | | 6,597 | | 6,597 | | | | 100.0 | |
| 1859 | | | | 9,655 | | 9,655 | | | | 100.0 | |
| 1869 | | | | 9,588 | | 9,588 | | | | 100.0 | |
| 1879 | 500 | | 100 | 13,164 | | 13,764 | 3.1 | | 0.5 | 96.4 | |
| 1889 | 1,000 | | 200 | 18,636 | | 19,836 | 4.4 | | .8 | 94.8 | |
| 1899 | 2,500 | 500 | 300 | 19,219 | | 22,519 | 9.8 | 2.0 | .9 | 87.3 | |
| 1909 | 4,500 | 4,000 | 450 | 21,857 | 300 | 31,107 | 13.0 | 11.7 | 1.3 | 73.2 | 0.8 |
| 1919 | 3,500 | 16,000 | 480 | 22,242 | 1,500 | 43,722 | 8.0 | 36.6 | 1.1 | 50.9 | 3.4 |
| 1923 | 3,000 | 21,920 | 500 | 19,800 | 2,200 | 47,420 | 6.3 | 46.3 | 1.1 | 41.7 | 4.6 |

**Ships** [•]

| Year | Horsepower (thousands) | | | | Percentage of each year's total | | | Year | Horsepower (thousands) | | | | Percentage of each year's total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Steam engines and turbines | Internal-combustion engines | Sails | Total | Steam engines and turbines | Internal-combustion engines | Sails | | Steam engines and turbines | Internal-combustion engines | Sails | Total | Steam engines and turbines | Internal-combustion engines | Sails |
| 1849 | 305 | | 429 | 734 | 41.6 | | 58.4 | 1899 | 1,542 | | 358 | 1,900 | 81.2 | | 18.8 |
| 1859 | 503 | | 639 | 1,142 | 44.0 | | 56.0 | 1909 | 2,750 | | 372 | 3,122 | 88.0 | | 12.0 |
| 1869 | 624 | | 452 | 1,076 | 58.1 | | 41.9 | 1919 | 5,734 | 495 | 356 | 6,585 | 87.0 | 7.6 | 5.4 |
| 1879 | 703 | | 407 | 1,110 | 63.3 | | 36.7 | 1923 | 9,247 | 664 | 351 | 10,262 | 90.1 | 6.5 | 3.4 |
| 1889 | 1,078 | | 366 | 1,444 | 74.7 | | 25.3 | | | | | | | | |

[4] Data furnished by C. D. Kinsman, U. S. Department of Agriculture.
[•] See Table 30.

NOTE.—Steam railroads are considered as having steam equipment only, electric power used on electrified divisions and tunnels being included with electric railroads. All automobiles are considered as having internal-combustion engines. Work animals not on farms are not apportioned among the other fields but are treated separately. For horsepower in these fields see other tables.

TABLE 6.—*Horsepower of prime movers, 1849–1923, by special groups*

**Horsepower (thousands)**

| Year | "Manufactures" [a] | "Materials" [b] | "Transportation" [c] | "Manufactures" and "materials" | "Transportation" exclusive of pleasure automobiles | "Heavy transportation" [d] | "Light transportation" [e] | "Electric motors" [f] |
|---|---|---|---|---|---|---|---|---|
| 1849 | 1,100 | 6,647 | 2,319 | 7,747 | 2,319 | 1,169 | 1,150 | ---------- |
| 1859 | 1,600 | 9,805 | 4,388 | 11,405 | 4,388 | 3,082 | 1,306 | ---------- |
| 1869 | 2,346 | 9,938 | 6,863 | 12,284 | 6,863 | 5,176 | 1,687 | ---------- |
| 1879 | 3,411 | 14,419 | 10,990 | 17,830 | 10,990 | 8,830 | 2,160 | ---------- |
| 1889 | 5,970 | 21,168 | 20,559 | 27,138 | 20,559 | 17,884 | 2,675 | ---------- |
| 1899 | 10,720 | 26,507 | 26,966 | 37,227 | 26,934 | 23,879 | 3,087 | 2,575 |
| 1909 | 20.894 | 36,076 | 63,359 | 56,970 | 55,936 | 52,240 | 11,119 | 11,878 |
| 1919 | 30,243 | 51,262 | 317,622 | 81,505 | 100,202 | 85,211 | 232,411 | 27,829 |
| 1923 | 34,344 | 56,220 | 600,600 | 90,564 | 148,612 | 91,646 | 508,954 | 34,922 |

**Index numbers (1899=100)**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1849 | 10 | 25 | 9 | 21 | 9 | 5 | 37 | ---------- |
| 1859 | 15 | 37 | 16 | 31 | 16 | 13 | 42 | ---------- |
| 1869 | 22 | 37 | 25 | 33 | 25 | 22 | 55 | ---------- |
| 1879 | 32 | 54 | 41 | 48 | 41 | 37 | 70 | ---------- |
| 1889 | 56 | 80 | 76 | 73 | 76 | 75 | 87 | ---------- |
| 1899 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1909 | 195 | 136 | 235 | 153 | 208 | 219 | 360 | 461 |
| 1919 | 282 | 193 | 1,178 | 219 | 372 | 357 | 7,529 | 1,081 |
| 1923 | 320 | 212 | 2,227 | 243 | 552 | 384 | 16,487 | 1,356 |

[a] Includes prime movers installed in manufactures and electric central stations minus the estimated prime movers of central stations utilized in mines and quarries, agriculture, and electric railroads. (See Tables 2, 3, and 5.)

[b] Includes prime movers utilized in mines and quarries, agriculture, and irrigation and drainage. (See Table 3.)

[c] Includes prime movers utilized in electric railroads, steam railroads, ships, automobiles, and work animals not on farms. (See Table 3.)

[d] Includes prime movers utilized in electric railroads, steam railroads, and ships. (See Table 3.)

[e] Includes horsepower of automobiles and work animals not on farms. (See Table 3.)

[f] Includes prime movers installed in central stations, electric railroads, and electric motors driven by the prime movers in manufactures and mines and quarries. (See Tables 2, 23, and 24.) No information available for mines and quarries in 1923.

TABLE 7.—*Population and wage earners in the United States, 1849–1923*

Thousands

| Year | Population [a] | Total wage earners [a] | Wage earners in— | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Manufactures [b] | Mines and quarries [a] | Agriculture [c] | Electric central stations [d] | Electric railroads [d] | Steam railroads [e] | Ships | "Manufactures" [f] | "Materials" [f] | "Heavy transportation" [f] | "Manufactures" and "materials" [f] |
| 1849 | 23,192 | 7,000 | 1,200 | 82 | 5,000 | ---------- | ---------- | 180 | 105 | 1,200 | 5,082 | 285 | 6,300 |
| 1859 | 31,443 | 10,500 | 1,500 | 158 | 5,600 | ---------- | ---------- | 250 | 102 | 1,500 | 5,758 | 352 | 7,200 |
| 1869 | 38,558 | 12,506 | 2,054 | 166 | 5,872 | ---------- | ---------- | 400 | 89 | 2,054 | 6,038 | 489 | 8,100 |
| 1879 | 50,156 | 17,392 | 2,733 | 249 | 7,663 | ---------- | ---------- | 550 | 89 | 2,733 | 7,912 | 639 | 10,645 |
| 1889 | 62,622 | 23,318 | 4,252 | 387 | 8,451 | 5 | 71 | 749 | 77 | 4,257 | 8,838 | 897 | 13,095 |
| 1899 | 75,995 | 29,073 | 5,306 | 620 | 10,249 | 25 | 132 | 929 | 78 | 5,331 | 10,869 | 1,139 | 16,200 |
| 1909 | 91,972 | 38,167 | 6,615 | 965 | 12,365 | 55 | 250 | 1,501 | 121 | 6,670 | 13,330 | 1,874 | 20,000 |
| 1919 | 105,711 | 41,614 | 9,041 | 1,090 | 10,646 | 120 | 296 | 1,913 | 173 | 9,116 | 11,736 | 2,382 | 20,950 |
| 1923 [g] | 110,000 | 43,500 | 8,778 | 1,150 | 10,000 | 140 | 305 | 1,850 | 200 | 8,918 | 11,150 | 2,455 | 20,068 |
| **Index numbers (1899=100)** | | | | | | | | | | | | | |
| 1849 | 30 | 24 | 23 | 13 | 49 | ---------- | ---------- | 19 | 135 | 22 | 47 | 25 | 39 |
| 1859 | 41 | 36 | 28 | 25 | 55 | ---------- | ---------- | 27 | 131 | 28 | 53 | 31 | 44 |
| 1869 | 51 | 43 | 39 | 27 | 57 | ---------- | ---------- | 43 | 114 | 39 | 56 | 43 | 50 |
| 1879 | 66 | 60 | 52 | 40 | 75 | ---------- | ---------- | 59 | 114 | 51 | 73 | 56 | 66 |
| 1889 | 82 | 80 | 80 | 62 | 82 | 20 | 54 | 81 | 99 | 80 | 81 | 79 | 81 |
| 1899 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1909 | 121 | 131 | 125 | 156 | 120 | 220 | 189 | 162 | 155 | 125 | 123 | 165 | 123 |
| 1919 | 139 | 143 | 170 | 176 | 104 | 480 | 224 | 206 | 222 | 171 | 108 | 209 | 129 |
| 1923 | 145 | 150 | 165 | 185 | 98 | 560 | 231 | 199 | 256 | 167 | 103 | 216 | 124 |

[a] Census reports.
[b] Census of manufactures.
[c] C. D. Kinsman, U. S. Department of Agriculture.
[d] Estimated from data in special census reports.
[e] Reports of Interstate Commerce Commission and U. S. Census.
[f] Groups are defined in footnotes to Table 6.
[g] Data for 1923, except for manufactures and agriculture, are estimated mainly from past growth.

TABLE 8.—*Horsepower of prime movers installed per inhabitant and per wage earner and utilized per wage earner in different activities and groups, 1849–1923* [a]

**Horsepower**

| Year | Installed [b] per— | | | | Utilized [c] per wage earner in— | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inhabitant | Wage earner | Inhabitant, exclusive of pleasure automobiles | Wage earner, exclusive of pleasure automobiles | Manufactures | Mines and quarries | Agriculture | Electric central stations | Electric railroads | Steam railroads | Ships | "Manufactures" | "Materials" | "Heavy transportation" | "Manufactures and "materials" |
| 1849 | 0.43 | 1.44 | 0.43 | 1.44 | 0.92 | 0.61 | 1.32 | ---------- | ---------- | 2.4 | 7.0 | 0.92 | 1.31 | 4.1 | 1.23 |
| 1859 | .50 | 1.50 | .50 | 1.50 | 1.07 | .95 | 1.72 | ---------- | ---------- | 7.8 | 11.2 | 1.07 | 1.70 | 8.8 | 1.58 |
| 1869 | .50 | 1.53 | .50 | 1.53 | 1.14 | 2.11 | 1.63 | ---------- | ---------- | 10.2 | 12.1 | 1.14 | 1.65 | 10.6 | 1.52 |
| 1879 | .58 | 1.66 | .58 | 1.66 | 1.25 | 2.61 | 1.80 | ---------- | ---------- | 14.0 | 12.5 | 1.25 | 1.82 | 13.8 | 1.68 |
| 1889 | .76 | 2.05 | .76 | 2.05 | 1.40 | 3.36 | 2.32 | 24.0 | 1.97 | 21.8 | 18.8 | 1.40 | 2.39 | 19.9 | 2.08 |
| 1899 | .85 | 2.21 | .85 | 2.21 | 1.90 | 4.63 | 2.29 | 48.0 | 8.18 | 22.5 | 24.3 | 2.02 | 2.44 | 21.0 | 2.30 |
| 1909 | 1.31 | 3.16 | 1.23 | 2.96 | 2.82 | 4.77 | 2.52 | 95.0 | 14.87 | 30.2 | 25.8 | 3.13 | 2.70 | 27.9 | 2.85 |
| 1919 | 3.75 | 9.52 | 1.67 | 4.25 | 3.26 | 6.17 | 4.10 | 127.5 | 21.40 | 37.8 | 38.1 | 3.32 | 4.37 | 35.8 | 3.90 |
| 1923 | 6.21 | 15.70 | 2.10 | 5.31 | 3.76 | 6.52 | 4.74 | 157.0 | 22.25 | 40.3 | 51.3 | 3.85 | 5.05 | 37.4 | 4.51 |

**Index numbers (1899=100)**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | 51 | 65 | 51 | 65 | 48 | 13 | 58 | ---------- | ---------- | 11 | 29 | 46 | 54 | 20 | 53 |
| 1859 | 59 | 68 | 59 | 68 | 56 | 21 | 75 | ---------- | ---------- | 35 | 46 | 53 | 70 | 42 | 69 |
| 1869 | 59 | 69 | 59 | 69 | 60 | 46 | 71 | ---------- | ---------- | 45 | 50 | 56 | 68 | 50 | 66 |
| 1879 | 68 | 75 | 68 | 75 | 66 | 56 | 79 | ---------- | ---------- | 62 | 51 | 62 | 75 | 66 | 73 |
| 1889 | 89 | 93 | 89 | 93 | 74 | 73 | 101 | 50 | 24 | 97 | 77 | 69 | 98 | 95 | 90 |
| 1899 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1909 | 154 | 143 | 145 | 134 | 148 | 103 | 110 | 198 | 182 | 134 | 106 | 155 | 111 | 133 | 124 |
| 1919 | 441 | 431 | 196 | 192 | 172 | 133 | 179 | 266 | 262 | 168 | 157 | 164 | 179 | 170 | 170 |
| 1923 | 731 | 710 | 247 | 240 | 198 | 141 | 207 | 327 | 272 | 179 | 211 | 190 | 207 | 178 | 196 |

[a] See Table 7 for sources of information.
[b] See Table 1 for total horsepower of prime movers.
[c] See Tables 3 and 6 for horsepower of prime movers utilized in the different activities and groups.

TABLE 9.—*Total horsepower, in thousands, of prime movers,[a] 1869–1923, by States and geographic divisions*

| Division and State | 1869 | | 1879 | | 1889 | | 1899 | | 1909 | | 1919 | | 1923 | | Exclusive of pleasure automobiles | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | 1919 | | 1923 | |
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------- | 11,934 | ------- | 17,175 | ------- | 27,129 | ------- | 40,086 | ------- | 63,812 | ------- | 321,839 | ------- | 607,745 | ------- | 102,371 | ------- | 154,215 |
| New England | 6 | 1,128 | 6 | 1,375 | 6 | 1,941 | 6 | 2,461 | 7 | 4,087 | 7 | 21,838 | 7 | 38,195 | 7 | 6,422 | 7 | 11,065 |
| Middle Atlantic | 2 | 2,232 | 3 | 2,665 | 3 | 4,204 | 3 | 7,083 | 3 | 11,933 | 3 | 55,523 | 2 | 111,988 | 2 | 20,381 | 2 | 33,410 |
| East North Central | 1 | 3,325 | 1 | 4,468 | 2 | 6,015 | 1 | 8,835 | 1 | 13,306 | 1 | 72,431 | 1 | 146,940 | 1 | 21,017 | 1 | 34,500 |
| West North Central | 5 | 1,316 | 2 | 3,179 | 1 | 6,328 | 2 | 8,756 | 2 | 12,820 | 2 | 61,560 | 3 | 98,274 | 3 | 18,312 | 3 | 23,809 |
| South Atlantic | 3 | 1,742 | 4 | 2,031 | 4 | 2,890 | 4 | 4,230 | 4 | 6,207 | 4 | 29,924 | 5 | 55,256 | 4 | 9,677 | 4 | 14,240 |
| East South Central | 4 | 1,335 | 5 | 1,641 | 5 | 2,317 | 5 | 3,111 | 6 | 4,316 | 8 | 14,352 | 8 | 25,026 | 8 | 5,986 | 8 | 6,765 |
| West South Central | 8 | 390 | 7 | 981 | 7 | 1,816 | 7 | 2,962 | 5 | 5,138 | 6 | 24,241 | 6 | 50,687 | 5 | 8,440 | 5 | 12,815 |
| Mountain | 9 | 47 | 9 | 137 | 9 | 346 | 9 | 867 | 9 | 2,126 | 9 | 13,837 | 9 | 21,486 | 9 | 4,431 | 9 | 6,195 |
| Pacific | 7 | 419 | 8 | 698 | 8 | 1,272 | 8 | 1,781 | 8 | 3,879 | 5 | 28,133 | 4 | 59,893 | 6 | 7,705 | 6 | 11,416 |
| New England: | | | | | | | | | | | | | | | | | | |
| Maine | 18 | 234 | 23 | 265 | 24 | 371 | 31 | 453 | 31 | 779 | 36 | 2,560 | 36 | 4,558 | 37 | 910 | 36 | 1,398 |
| New Hampshire | 21 | 202 | 29 | 198 | 35 | 217 | 36 | 299 | 39 | 331 | 42 | 1,315 | 42 | 2,475 | 42 | 402 | 42 | 630 |
| Vermont | 20 | 204 | 24 | 228 | 33 | 259 | 38 | 268 | 38 | 346 | 45 | 1,121 | 44 | 2,181 | 43 | 381 | 44 | 511 |
| Massachusetts | 17 | 270 | 17 | 404 | 16 | 684 | 17 | 909 | 13 | 1,747 | 9 | 10,681 | 10 | 19,370 | 10 | 3,061 | 8 | 5,530 |
| Rhode Island | 33 | 61 | 34 | 79 | 38 | 137 | 41 | 160 | 41 | 296 | 39 | 1,921 | 39 | 3,131 | 40 | 530 | 39 | 1,011 |
| Connecticut | 26 | 157 | 28 | 201 | 31 | 273 | 34 | 372 | 35 | 588 | 26 | 4,190 | 28 | 6,480 | 32 | 1,138 | 23 | 1,985 |
| Middle Atlantic: | | | | | | | | | | | | | | | | | | |
| New York | 1 | 1,118 | 1 | 1,308 | 1 | 2,080 | 2 | 2,858 | 2 | 4,945 | 1 | 25,102 | 1 | 51,015 | 1 | 9,620 | 1 | 16,935 |
| New Jersey | 24 | 165 | 30 | 198 | 29 | 313 | 27 | 546 | 26 | 949 | 16 | 7,335 | 14 | 16,123 | 21 | 1,775 | 10 | 4,525 |
| Pennsylvania | 3 | 949 | 3 | 1,159 | 2 | 1,811 | 1 | 3,679 | 1 | 6,039 | 2 | 23,086 | 2 | 44,850 | 2 | 8,986 | 2 | 11,950 |
| East North Central: | | | | | | | | | | | | | | | | | | |
| Ohio | 4 | 903 | 4 | 1,142 | 4 | 1,535 | 3 | 2,457 | 3 | 4,006 | 3 | 21,651 | 4 | 42,315 | 3 | 6,559 | 3 | 10,885 |
| Indiana | 5 | 618 | 7 | 757 | 9 | 1,026 | 10 | 1,401 | 12 | 1,961 | 13 | 9,578 | 9 | 21,580 | 13 | 3,012 | 9 | 5,300 |
| Illinois | 2 | 1,076 | 2 | 1,459 | 3 | 1,769 | 4 | 2,385 | 4 | 3,647 | 4 | 19,352 | 5 | 37,884 | 4 | 5,532 | 4 | 9,174 |
| Michigan | 12 | 366 | 10 | 564 | 10 | 935 | 7 | 1,544 | 9 | 2,163 | 8 | 12,456 | 6 | 27,510 | 7 | 3,514 | 7 | 5,780 |
| Wisconsin | 13 | 362 | 11 | 546 | 13 | 750 | 14 | 1,048 | 15 | 1,529 | 14 | 9,394 | 13 | 17,651 | 15 | 2,400 | 15 | 3,361 |
| West North Central: | | | | | | | | | | | | | | | | | | |
| Minnesota | 28 | 135 | 18 | 398 | 15 | 730 | 9 | 1,410 | 11 | 2,049 | 12 | 9,664 | 12 | 17,995 | 8 | 3,214 | 12 | 4,475 |
| Iowa | 6 | 519 | 5 | 1,032 | 5 | 1,473 | 5 | 1,847 | 10 | 2,150 | 6 | 13,821 | 8 | 22,135 | 11 | 3,033 | 13 | 4,030 |
| Missouri | 7 | 516 | 6 | 893 | 7 | 1,271 | 6 | 1,672 | 6 | 2,263 | 10 | 10,265 | 11 | 19,094 | 9 | 3,125 | 11 | 4,514 |
| North Dakota | ------- | ------- | 46 | 1 | 32 | 262 | 26 | 552 | 16 | 1,351 | 21 | 4,491 | 33 | 5,644 | 18 | 1,999 | 22 | 2,057 |
| South Dakota | ------- | ------- | 38 | 42 | 23 | 403 | 23 | 653 | 22 | 1,059 | 22 | 4,465 | 30 | 5,860 | 26 | 1,425 | 28 | 1,757 |
| Nebraska | 36 | 32 | 21 | 270 | 11 | 877 | 12 | 1,110 | 14 | 1,669 | 15 | 8,686 | 17 | 11,868 | 14 | 2,494 | 16 | 3,073 |
| Kansas | 30 | 114 | 12 | 543 | 6 | 1,312 | 8 | 1,512 | 5 | 2,279 | 11 | 10,168 | 15 | 15,678 | 12 | 3,022 | 14 | 3,903 |

[a] Manufactures and agriculture, 1869–1923; plus mines and quarries, central stations, electric railroads, 1899–1923; plus irrigation and drainage, 1909–1923; plus automobiles, 1919–1923. Steam railroads and work animals not on farms not included. No duplication in figures.

TABLE 9.—*Total horsepower, in thousands, of prime movers, 1869–1923, by States and geographic divisions*—Continued

| Division and State | 1869 | | 1879 | | 1889 | | 1899 | | 1909 | | 1919 | | 1923 | | Exclusive of pleasure automobiles | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | 1919 | | 1923 | |
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| South Atlantic: | | | | | | | | | | | | | | | | | | |
| Delaware | 34 | 47 | 37 | 42 | 41 | 50 | 45 | 54 | 48 | 81 | 48 | 628 | 49 | 1,230 | 49 | 161 | 47 | 384 |
| Maryland | 22 | 176 | 26 | 215 | 28 | 315 | 32 | 440 | 33 | 645 | 28 | 3,766 | 24 | 7,059 | 36 | 1,004 | 29 | 1,712 |
| District of Columbia | 43 | 2 | 45 | 3 | 48 | 17 | 49 | 23 | 49 | 41 | 43 | 1,230 | 41 | 2,728 | 47 | 203 | 45 | 444 |
| Virginia | 8 | 464 | 14 | 468 | 19 | 607 | 19 | 780 | 21 | 1,131 | 23 | 4,428 | 20 | 9,274 | 22 | 1,740 | 18 | 2,890 |
| West Virginia | 25 | 161 | 27 | 215 | 27 | 319 | 22 | 672 | 25 | 1,016 | 33 | 3,024 | 25 | 6,764 | 24 | 1,624 | 30 | 1,675 |
| North Carolina | 15 | 302 | 19 | 360 | 21 | 514 | 21 | 685 | 27 | 937 | 20 | 4,753 | 19 | 9,624 | 27 | 1,373 | 24 | 1,975 |
| South Carolina | 23 | 168 | 25 | 218 | 25 | 349 | 30 | 488 | 30 | 782 | 30 | 3,508 | 34 | 5,497 | 33 | 1,121 | 32 | 1,569 |
| Georgia | 11 | 380 | 16 | 462 | 17 | 635 | 16 | 916 | 19 | 1,255 | 18 | 6,390 | 22 | 7,369 | 19 | 1,840 | 21 | 2,240 |
| Florida | 35 | 42 | 36 | 48 | 39 | 84 | 40 | 172 | 40 | 319 | 38 | 2,197 | 31 | 5,711 | 38 | 611 | 37 | 1,351 |
| East South Central: | | | | | | | | | | | | | | | | | | |
| Kentucky | 9 | 448 | 9 | 580 | 14 | 749 | 15 | 994 | 18 | 1,288 | 25 | 4,252 | 21 | 7,897 | 23 | 1,641 | 27 | 1,870 |
| Tennessee | 10 | 385 | 15 | 465 | 18 | 608 | 18 | 795 | 23 | 1,058 | 27 | 3,841 | 23 | 7,104 | 25 | 1,496 | 26 | 1,879 |
| Alabama | 16 | 279 | 20 | 330 | 20 | 544 | 20 | 760 | 20 | 1,140 | 31 | 3,465 | 32 | 5,706 | 20 | 1,801 | 25 | 1,882 |
| Mississippi | 19 | 223 | 22 | 266 | 22 | 416 | 24 | 562 | 29 | 830 | 34 | 2,794 | 37 | 4,319 | 35 | 1,048 | 38 | 1,134 |
| West South Central: | | | | | | | | | | | | | | | | | | |
| Arkansas | 31 | 104 | 31 | 195 | 26 | 336 | 28 | 523 | 32 | 749 | 37 | 2,545 | 35 | 4,895 | 34 | 1,092 | 35 | 1,428 |
| Louisiana | 29 | 131 | 32 | 135 | 30 | 278 | 25 | 561 | 28 | 842 | 35 | 2,698 | 29 | 6,199 | 29 | 1,222 | 20 | 2,267 |
| Oklahoma | | | | | 43 | 40 | 29 | 505 | 17 | 1,336 | 19 | 5,460 | 16 | 12,515 | 17 | 2,159 | 19 | 2,775 |
| Texas | 27 | 155 | 8 | 651 | 8 | 1,162 | 11 | 1,373 | 7 | 2,211 | 7 | 13,538 | 7 | 27,078 | 6 | 3,967 | 6 | 6,345 |
| Mountain: | | | | | | | | | | | | | | | | | | |
| Montana | 42 | 2 | 43 | 15 | 40 | 63 | 39 | 218 | 37 | 525 | 32 | 3,044 | 38 | 3,831 | 28 | 1,252 | 31 | 1,612 |
| Idaho | 44 | 1 | 41 | 16 | 42 | 42 | 42 | 100 | 42 | 277 | 40 | 1,841 | 40 | 2,805 | 39 | 607 | 40 | 871 |
| Wyoming | | | 47 | 1 | 45 | 22 | 44 | 72 | 46 | 137 | 46 | 900 | 46 | 1,627 | 45 | 275 | 46 | 433 |
| Colorado | 37 | 21 | 35 | 59 | 37 | 151 | 37 | 285 | 36 | 562 | 24 | 4,268 | 26 | 6,720 | 31 | 1,146 | 34 | 1,453 |
| New Mexico | 39 | 11 | 44 | 11 | 46 | 22 | 47 | 38 | 45 | 141 | 47 | 765 | 47 | 1,355 | 46 | 232 | 48 | 337 |
| Arizona | | | 48 | 1 | 49 | 1 | 46 | 45 | 44 | 171 | 44 | 1,212 | 45 | 2,128 | 44 | 381 | 41 | 683 |
| Utah | 41 | 3 | 40 | 19 | 44 | 25 | 43 | 77 | 43 | 221 | 41 | 1,435 | 43 | 2,362 | 41 | 440 | 43 | 612 |
| Nevada | 40 | 9 | 42 | 15 | 47 | 20 | 48 | 32 | 47 | 92 | 49 | 372 | 48 | 658 | 48 | 98 | 49 | 194 |
| Pacific: | | | | | | | | | | | | | | | | | | |
| Washington | 38 | 13 | 39 | 32 | 36 | 162 | 33 | 389 | 24 | 1,050 | 17 | 6,713 | 18 | 10,588 | 16 | 2,333 | 17 | 3,068 |
| Oregon | 32 | 66 | 33 | 124 | 34 | 257 | 35 | 319 | 34 | 635 | 29 | 3,595 | 27 | 6,677 | 30 | 1,185 | 33 | 1,500 |
| California | 14 | 340 | 13 | 542 | 12 | 853 | 13 | 1,073 | 8 | 2,194 | 5 | 17,825 | 3 | 42,628 | 5 | 4,187 | 5 | 6,848 |

TABLE 10.—*Horsepower of prime movers per square mile, 1923, by States and geographic divisions*[a]

| Division and State | Total | Manufactures | Agriculture |
|---|---|---|---|
| United States | 204.4 | 11.1 | 12.8 |
| New England | 616.3 | 67.0 | 8.9 |
| Middle Atlantic | 1,120.0 | 96.3 | 20.1 |
| East North Central | 598.0 | 37.0 | 27.7 |
| West North Central | 192.4 | 3.4 | 26.3 |
| South Atlantic | 205.4 | 11.7 | 11.8 |
| East South Central | 139.5 | 8.1 | 14.1 |
| West South Central | 118.0 | 3.0 | 11.8 |
| Mountain | 25.0 | .9 | 2.9 |
| Pacific | 188.3 | 5.9 | 6.4 |
| New England: | | | |
| Maine | 152.5 | 19.1 | 6.3 |
| New Hampshire | 274.1 | 39.1 | ------- |
| Vermont | 239.0 | 19.4 | 13.9 |
| Massachusetts | 2,409.5 | 240.4 | 13.3 |
| Rhode Island | 2,934.4 | 367.4 | ------- |
| Connecticut | 1,344.4 | 150.8 | 26.1 |
| Middle Atlantic: | | | |
| New York | 1,070.5 | 68.5 | 19.7 |
| New Jersey | 2,145.7 | 167.2 | 19.7 |
| Pennsylvania | 1,001.4 | 113.9 | 20.5 |
| East North Central: | | | |
| Ohio | 1,038.7 | 81.2 | 34.5 |
| Indiana | 598.7 | 38.1 | 35.2 |
| Illinois | 676.0 | 35.3 | 37.0 |
| Michigan | 478.6 | 25.6 | 17.9 |
| Wisconsin | 319.4 | 16.8 | 18.6 |
| West North Central: | | | |
| Minnesota | 222.6 | 5.7 | 19.8 |
| Iowa | 398.2 | 5.1 | 39.7 |
| Missouri | 277.8 | 8.0 | 29.6 |
| North Dakota | 80.4 | .2 | 26.9 |
| South Dakota | 76.2 | .2 | 17.4 |
| Nebraska | 154.5 | 1.7 | 25.3 |
| Kansas | 191.7 | 3.1 | 29.5 |
| South Atlantic: | | | |
| Delaware | 626.0 | 57.0 | ------- |
| Maryland | 710.1 | 50.1 | 21.7 |
| District of Columbia | 45,466.7 | 533.3 | ------- |
| Virginia | 230.3 | 10.7 | 17.5 |
| West Virginia | 281.6 | 15.5 | 14.9 |
| North Carolina | 197.5 | 14.5 | 11.9 |
| South Carolina | 180.2 | 13.4 | 13.7 |
| Georgia | 125.5 | 7.7 | 13.3 |
| Florida | 104.1 | 2.5 | 2.4 |
| East South Central: | | | |
| Kentucky | 196.5 | 6.3 | 19.0 |
| Tennessee | 170.4 | 9.4 | 17.5 |
| Alabama | 111.3 | 12.5 | 9.7 |
| Mississippi | 93.4 | 3.8 | 11.7 |
| West South Central: | | | |
| Arkansas | 93.2 | 3.1 | 13.6 |
| Louisiana | 136.5 | 8.9 | 10.1 |
| Oklahoma | 180.3 | 2.2 | 20.8 |
| Texas | 103.2 | 2.1 | 9.4 |
| Mountain: | | | |
| Montana | 26.2 | 1.3 | 5.9 |
| Idaho | 33.6 | .9 | 6.1 |
| Wyoming | 16.7 | .2 | 1.7 |
| Colorado | 64.8 | 1.7 | 6.0 |
| New Mexico | 11.1 | .1 | 1.0 |
| Arizona | 18.7 | 1.1 | 1.0 |
| Utah | 28.7 | 1.7 | 1.6 |
| Nevada | 6.0 | .3 | .6 |
| Pacific: | | | |
| Washington | 158.4 | 8.9 | 9.8 |
| Oregon | 69.8 | 3.4 | 3.8 |
| California | 273.9 | 6.1 | 6.6 |

[a] Based on land area of the United States, horsepower as given in Table 9 for total, Table 11 for manufactures, and Table 14 for agriculture.

TABLE 11.—*Horsepower, in thousands, of prime movers utilized by manufactures, 1869–1923, by States and geographic divisions*[a]

| Division and State | 1869 | | 1879 | | 1889 | | 1899 | | 1909 | | 1919 | | 1923 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------ | 2,346 | ------ | 3,411 | ------ | 5,939 | ------ | 10,098 | ------ | 18,675 | ------ | 29,505 | ------ | 33,094 |
| New England | 3 | 514 | 3 | 743 | 3 | 1,158 | 3 | 1,531 | 3 | 2,715 | 3 | 3,797 | 3 | 4,151 |
| Middle Atlantic | 1 | 757 | 1 | 1,067 | 1 | 1,935 | 1 | 2,834 | 1 | 5,534 | 1 | 8,538 | 1 | 9,627 |
| East North Central | 2 | 530 | 2 | 808 | 2 | 1,329 | 2 | 2,304 | 2 | 4,381 | 2 | 7,735 | 2 | 9,062 |
| West North Central | 5 | 132 | 5 | 220 | 5 | 416 | 7 | 655 | 5 | 1,101 | 6 | 1,594 | 6 | 1,714 |
| South Atlantic | 4 | 210 | 4 | 293 | 4 | 466 | 4 | 1,030 | 4 | 1,832 | 4 | 2,796 | 4 | 3,144 |
| East South Central | 6 | 109 | 6 | 153 | 6 | 303 | 5 | 677 | 6 | 1,036 | 7 | 1,416 | 7 | 1,462 |
| West South Central | 7 | 46 | 7 | 58 | 8 | 136 | 6 | 664 | 7 | 873 | 8 | 1,186 | 8 | 1,269 |
| Mountain | 9 | 12 | 9 | 18 | 9 | 48 | 9 | 125 | 9 | 401 | 9 | 686 | 9 | 778 |
| Pacific | 8 | 36 | 8 | 51 | 7 | 148 | 8 | 278 | 8 | 802 | 5 | 1,757 | 5 | 1,887 |
| New England: | | | | | | | | | | | | | | |
| Maine | 9 | 80 | 10 | 100 | 11 | 150 | 12 | 239 | 10 | 460 | 15 | 547 | 15 | 570 |
| New Hampshire | 10 | 77 | 12 | 88 | 13 | 117 | 17 | 199 | 19 | 294 | 24 | 349 | 27 | 353 |
| Vermont | 14 | 51 | 15 | 63 | 17 | 98 | 26 | 127 | 33 | 159 | 35 | 185 | 34 | 177 |
| Massachusetts | 3 | 184 | 3 | 310 | 3 | 516 | 4 | 603 | 4 | 1,175 | 4 | 1,730 | 5 | 1,932 |
| Rhode Island | 16 | 42 | 14 | 64 | 14 | 113 | 25 | 132 | 26 | 227 | 27 | 321 | 24 | 392 |
| Connecticut | 8 | 80 | 8 | 118 | 10 | 164 | 13 | 231 | 11 | 400 | 12 | 665 | 11 | 727 |
| Middle Atlantic: | | | | | | | | | | | | | | |
| New York | 2 | 334 | 2 | 454 | 2 | 773 | 2 | 1,004 | 2 | 2,020 | 2 | 2,937 | 3 | 3,263 |
| New Jersey | 12 | 59 | 11 | 100 | 8 | 178 | 7 | 335 | 7 | 612 | 7 | 1,147 | 8 | 1,257 |
| Pennsylvania | 1 | 364 | 1 | 513 | 1 | 984 | 1 | 1,495 | 1 | 2,902 | 1 | 4,454 | 1 | 5,107 |
| East North Central: | | | | | | | | | | | | | | |
| Ohio | 4 | 174 | 4 | 261 | 4 | 417 | 3 | 805 | 3 | 1,583 | 3 | 2,897 | 2 | 3,308 |
| Indiana | 6 | 100 | 7 | 132 | 7 | 191 | 8 | 297 | 6 | 633 | 8 | 1,096 | 7 | 1,372 |
| Illinois | 7 | 86 | 6 | 144 | 5 | 286 | 5 | 514 | 5 | 1,013 | 5 | 1,661 | 4 | 1,980 |
| Michigan | 5 | 106 | 5 | 165 | 6 | 257 | 6 | 398 | 8 | 598 | 6 | 1,202 | 6 | 1,472 |
| Wisconsin | 11 | 64 | 9 | 106 | 9 | 178 | 9 | 290 | 9 | 554 | 9 | 879 | 10 | 930 |
| West North Central: | | | | | | | | | | | | | | |
| Minnesota | 26 | 20 | 18 | 54 | 15 | 113 | 18 | 189 | 18 | 298 | 17 | 474 | 19 | 460 |
| Iowa | 17 | 40 | 19 | 54 | 22 | 78 | 29 | 121 | 34 | 155 | 30 | 243 | 29 | 283 |
| Missouri | 13 | 55 | 13 | 81 | 12 | 149 | 15 | 210 | 15 | 340 | 16 | 477 | 16 | 553 |
| North Dakota | ------ | ------ | 42 | 1 | 42 | 4 | 45 | 8 | 47 | 13 | 47 | 18 | 47 | 17 |
| South Dakota | ------ | ------ | 43 | 1 | 40 | 6 | 41 | 12 | 44 | 18 | 45 | 22 | 49 | 16 |
| Nebraska | 31 | 9 | 35 | 8 | 37 | 23 | 36 | 44 | 39 | 64 | 39 | 126 | 40 | 129 |
| Kansas | 33 | 8 | 29 | 21 | 29 | 43 | 33 | 71 | 29 | 213 | 31 | 234 | 30 | 256 |
| South Atlantic: | | | | | | | | | | | | | | |
| Delaware | 32 | 9 | 32 | 15 | 36 | 26 | 37 | 41 | 40 | 53 | 42 | 85 | 42 | 112 |
| Maryland | 22 | 32 | 21 | 51 | 23 | 73 | 24 | 138 | 27 | 218 | 21 | 407 | 18 | 498 |
| District of Columbia | 41 | 2 | 40 | 3 | 39 | 11 | 42 | 10 | 45 | 17 | 44 | 33 | 44 | 32 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Virginia | 15 | 50 | 16 | 57 | 20 | 82 | 21 | 165 | 21 | 284 | 20 | 420 | 21 | 431 |
| West Virginia | 23 | 27 | 24 | 38 | 27 | 55 | 31 | 106 | 28 | 217 | 26 | 329 | 26 | 372 |
| North Carolina | 21 | 33 | 23 | 45 | 24 | 73 | 16 | 201 | 12 | 379 | 14 | 550 | 12 | 703 |
| South Carolina | 28 | 15 | 28 | 26 | 28 | 46 | 23 | 140 | 23 | 276 | 22 | 396 | 22 | 408 |
| Georgia | 19 | 38 | 22 | 51 | 18 | 84 | 19 | 180 | 20 | 298 | 19 | 437 | 20 | 450 |
| Florida | 35 | 4 | 36 | 7 | 38 | 16 | 39 | 40 | 37 | 90 | 38 | 139 | 39 | 138 |
| East South Central: | | | | | | | | | | | | | | |
| Kentucky | 18 | 40 | 17 | 55 | 21 | 82 | 22 | 163 | 25 | 230 | 29 | 248 | 31 | 252 |
| Tennessee | 20 | 38 | 20 | 52 | 19 | 84 | 20 | 168 | 24 | 242 | 25 | 339 | 25 | 391 |
| Alabama | 27 | 19 | 27 | 28 | 16 | 102 | 14 | 222 | 13 | 358 | 13 | 628 | 13 | 641 |
| Mississippi | 30 | 12 | 30 | 18 | 32 | 35 | 28 | 124 | 30 | 206 | 34 | 201 | 33 | 178 |
| West South Central: | | | | | | | | | | | | | | |
| Arkansas | 34 | 8 | 31 | 16 | 31 | 38 | 30 | 120 | 32 | 173 | 32 | 214 | 36 | 165 |
| Louisiana | 24 | 25 | 34 | 11 | 35 | 30 | 11 | 256 | 14 | 347 | 23 | 389 | 23 | 403 |
| Oklahoma | | | | | | | 44 | 9 | 38 | 71 | 37 | 140 | 37 | 153 |
| Texas | 29 | 13 | 26 | 31 | 26 | 68 | 10 | 279 | 22 | 282 | 18 | 443 | 17 | 548 |
| Mountain: | | | | | | | | | | | | | | |
| Montana | 39 | 2 | 44 | 1 | 43 | 3 | 38 | 41 | 36 | 90 | 36 | 153 | 32 | 191 |
| Idaho | 42 | 1 | 41 | 2 | 44 | 2 | 46 | 7 | 41 | 43 | 43 | 74 | 43 | 72 |
| Wyoming | | | 45 | 1 | 45 | 2 | 47 | 4 | 48 | 8 | 48 | 18 | 46 | 24 |
| Colorado | 40 | 2 | 37 | 6 | 33 | 33 | 35 | 44 | 35 | 155 | 33 | 206 | 35 | 176 |
| New Mexico | 43 | 1 | 46 | 1 | 46 | 2 | 48 | 4 | 46 | 15 | 49 | 17 | 48 | 17 |
| Arizona | | | 47 | 1 | 47 | 1 | 43 | 9 | 43 | 39 | 40 | 104 | 41 | 129 |
| Utah | 36 | 3 | 38 | 5 | 41 | 5 | 40 | 14 | 42 | 43 | 41 | 94 | 38 | 141 |
| Nevada | 37 | 3 | 48 | 1 | | | 49 | 2 | 49 | 8 | 46 | 20 | 45 | 28 |
| Pacific: | | | | | | | | | | | | | | |
| Washington | 38 | 3 | 39 | 4 | 30 | 43 | 32 | 88 | 17 | 298 | 11 | 687 | 14 | 593 |
| Oregon | 33 | 8 | 33 | 14 | 34 | 32 | 34 | 63 | 31 | 175 | 28 | 304 | 28 | 322 |
| California | 25 | 25 | 25 | 33 | 25 | 73 | 27 | 127 | 16 | 329 | 10 | 766 | 9 | 972 |

[a] From census of manufactures; includes horsepower of motors operated by purchased power.

TABLE 12.—*Percentage of total horsepower of prime movers utilized in manufactures, 1923, by types of prime movers*[a]

| Division and State | Steam engines and turbines | Internal-combustion engines | Water wheels | Motors operated by purchased electricity |
|---|---|---|---|---|
| United States | 50.47 | 3.71 | 5.45 | 40.37 |
| New England | 42.80 | 1.13 | 18.33 | 37.14 |
| Middle Atlantic | 54.85 | 4.23 | 4.04 | 36.88 |
| East North Central | 50.40 | 4.93 | 2.63 | 42.04 |
| West North Central | 44.88 | 5.13 | 4.27 | 45.72 |
| South Atlantic | 46.90 | 2.66 | 8.23 | 42.21 |
| East South Central | 60.65 | 1.38 | 1.13 | 36.84 |
| West South Central | 66.12 | 6.78 | .56 | 26.54 |
| Mountain | 45.93 | 2.97 | 1.18 | 49.92 |
| Pacific | 39.77 | 1.48 | 2.65 | 56.10 |
| New England: | | | | |
| Maine | 28.55 | 1.13 | 46.15 | 24.17 |
| New Hampshire | 41.03 | .97 | 43.70 | 14.30 |
| Vermont | 27.02 | .66 | 36.45 | 35.87 |
| Massachusetts | 47.96 | .77 | 9.80 | 41.47 |
| Rhode Island | 47.84 | 3.11 | 6.95 | 42.10 |
| Connecticut | 42.55 | .95 | 8.58 | 47.92 |
| Middle Atlantic: | | | | |
| New York | 38.10 | 3.64 | 10.66 | 47.60 |
| New Jersey | 62.35 | 2.79 | .86 | 34.00 |
| Pennsylvania | 63.63 | .57 | 4.84 | 30.96 |
| East North Central: | | | | |
| Ohio | 55.72 | 4.27 | .38 | 39.63 |
| Indiana | 49.98 | 12.27 | .62 | 37.13 |
| Illinois | 47.64 | 3.90 | .51 | 47.95 |
| Michigan | 45.70 | 3.09 | 2.91 | 48.30 |
| Wisconsin | 45.37 | 1.73 | 17.74 | 35.16 |
| West North Central: | | | | |
| Minnesota | 45.05 | 4.17 | 13.65 | 37.13 |
| Iowa | 44.22 | 1.69 | .67 | 53.42 |
| Missouri | 41.81 | 3.75 | .34 | 54.10 |
| North Dakota | 62.12 | 10.62 | .54 | 26.72 |
| South Dakota | 35.50 | 6.70 | 1.78 | 56.02 |
| Nebraska | 41.45 | 11.90 | 2.40 | 44.25 |
| Kansas | 52.86 | 9.82 | 1.22 | 36.10 |
| South Atlantic: | | | | |
| Delaware | 60.45 | 1.17 | 1.63 | 36.75 |
| Maryland | 34.22 | 2.19 | 1.13 | 62.46 |
| District of Columbia | 35.65 | 2.81 | 3.05 | 58.49 |
| Virginia | 53.35 | 2.56 | 10.95 | 33.14 |
| West Virginia | 58.58 | 9.51 | 1.27 | 30.64 |
| North Carolina | 34.90 | .84 | 20.90 | 43.36 |
| South Carolina | 48.05 | 1.84 | 6.95 | 43.16 |
| Georgia | 51.03 | .80 | 5.10 | 43.07 |
| Florida | 77.15 | 4.88 | .11 | 17.86 |
| East South Central: | | | | |
| Kentucky | 46.20 | 2.80 | .98 | 50.02 |
| Tennessee | 56.41 | 1.12 | 1.07 | 41.40 |
| Alabama | 61.80 | .51 | 1.48 | 36.21 |
| Mississippi | 86.30 | 3.04 | .23 | 10.43 |
| West South Central: | | | | |
| Arkansas | 81.42 | 3.66 | .22 | 14.70 |
| Louisiana | 82.91 | 4.19 | .08 | 12.82 |
| Oklahoma | 55.23 | 12.20 | .14 | 32.43 |
| Texas | 52.07 | 8.09 | 1.14 | 38.80 |
| Mountain: | | | | |
| Montana | 15.80 | .77 | 2.37 | 81.06 |
| Idaho | 64.82 | 2.38 | .58 | 32.22 |
| Wyoming | 58.64 | 7.92 | .41 | 33.03 |
| Colorado | 62.15 | 1.22 | .38 | 36.25 |
| New Mexico | 38.37 | 5.71 | 1.84 | 14.08 |
| Arizona | 66.40 | 10.56 | .05 | 22.99 |
| Utah | 27.07 | .36 | 1.77 | 70.80 |
| Nevada | 72.62 | 3.36 | 2.25 | 21.77 |
| Pacific: | | | | |
| Washington | 60.54 | 1.77 | 1.05 | 36.64 |
| Oregon | 52.67 | .51 | 10.28 | 36.54 |
| California | 22.60 | 1.62 | 1.12 | 74.66 |

[a] Based on Table 37.

TABLE 13.—*Horsepower, in thousands, of prime movers utilized in mines and quarries, 1899–1923, by States and geographic divisions* [a]

| Division and State | 1899 | | 1909 | | 1919 | | 1923 | |
|---|---|---|---|---|---|---|---|---|
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------- | 2,868 | ------- | 4,608 | ------- | 6,724 | ------- | 7,500 |
| New England | 8 | 45 | 9 | 61 | 9 | 62 | 9 | 76 |
| Middle Atlantic | 1 | 1,302 | 1 | 1,760 | 1 | 2,125 | 1 | 2,211 |
| East North Central | 2 | 657 | 2 | 914 | 2 | 1,151 | 2 | 1,236 |
| West North Central | 5 | 135 | 5 | 371 | 6 | 426 | 7 | 462 |
| South Atlantic | 3 | 309 | 3 | 536 | 3 | 850 | 4 | 920 |
| East South Central | 7 | 67 | 7 | 180 | 8 | 352 | 8 | 416 |
| West South Central | 9 | 24 | 8 | 149 | 5 | 684 | 5 | 775 |
| Mountain | 4 | 237 | 4 | 446 | 4 | 717 | 3 | 921 |
| Pacific | 6 | 92 | 6 | 191 | 7 | 357 | 6 | 483 |
| New England: | | | | | | | | |
| Maine | 35 | 7 | 39 | 8 | 39 | 6 | 41 | 8 |
| New Hampshire | 42 | 3 | 43 | 4 | 43 | 4 | 42 | 7 |
| Vermont | 23 | 15 | 25 | 26 | 31 | 28 | 31 | 35 |
| Massachusetts | 30 | 11 | 33 | 15 | 37 | 12 | 35 | 15 |
| Rhode Island | 45 | 1 | 44 | 2 | 44 | 3 | 44 | 2 |
| Connecticut | 34 | 8 | 42 | 6 | 38 | 9 | 39 | 9 |
| Middle Atlantic: | | | | | | | | |
| New York | 8 | 85 | 10 | 102 | 18 | 92 | 18 | 110 |
| New Jersey | 15 | 22 | 30 | 18 | 28 | 34 | 29 | 40 |
| Pennsylvania | 1 | 1,195 | 1 | 1,640 | 1 | 1,999 | 1 | 2,061 |
| East North Central: | | | | | | | | |
| Ohio | 3 | 211 | 3 | 295 | 5 | 338 | 5 | 358 |
| Indiana | 5 | 132 | 12 | 95 | 14 | 130 | 15 | 141 |
| Illinois | 6 | 96 | 5 | 225 | 6 | 318 | 7 | 346 |
| Michigan | 4 | 205 | 4 | 274 | 4 | 338 | 6 | 355 |
| Wisconsin | 26 | 13 | 26 | 25 | 32 | 27 | 30 | 36 |
| West North Central: | | | | | | | | |
| Minnesota | 13 | 30 | 8 | 152 | 12 | 144 | 12 | 160 |
| Iowa | 24 | 15 | 27 | 23 | 29 | 32 | 32 | 32 |
| Missouri | 11 | 52 | 9 | 110 | 17 | 100 | 20 | 105 |
| North Dakota | 44 | 1 | 45 | 2 | 45 | 2 | 46 | 1 |
| South Dakota | 25 | 14 | 31 | 16 | 36 | 12 | 37 | 12 |
| Nebraska | ------- | ------- | 46 | 1 | 46 | 2 | 45 | 2 |
| Kansas | 14 | 23 | 15 | 67 | 13 | 134 | 14 | 150 |
| South Atlantic: | | | | | | | | |
| Delaware | 43 | 2 | 47 | 1 | 47 | 1 | 47 | 1 |
| Maryland | 22 | 15 | 29 | 18 | 34 | 19 | 34 | 17 |
| District of Columbia | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Virginia | 18 | 19 | 20 | 35 | 23 | 58 | 23 | 74 |
| West Virginia | 2 | 244 | 2 | 416 | 2 | 704 | 2 | 750 |
| North Carolina | 41 | 4 | 41 | 6 | 41 | 5 | 40 | 9 |
| South Carolina | 38 | 5 | 40 | 7 | 42 | 5 | 43 | 6 |
| Georgia | 31 | 10 | 35 | 11 | 35 | 13 | 36 | 14 |
| Florida | 32 | 10 | 19 | 42 | 26 | 45 | 27 | 49 |
| East South Central: | | | | | | | | |
| Kentucky | 17 | 20 | 16 | 53 | 9 | 149 | 10 | 174 |
| Tennessee | 21 | 15 | 21 | 35 | 24 | 57 | 25 | 67 |
| Alabama | 12 | 32 | 14 | 92 | 10 | 146 | 9 | 175 |
| Mississippi | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| West South Central: | | | | | | | | |
| Arkansas | 36 | 7 | 34 | 14 | 33 | 21 | 33 | 26 |
| Louisiana | 40 | 4 | 38 | 8 | 20 | 86 | 21 | 90 |
| Oklahoma | ------- | ------- | 13 | 95 | 3 | 448 | 3 | 503 |
| Texas | 27 | 13 | 22 | 32 | 15 | 129 | 13 | 156 |
| Mountain: | | | | | | | | |
| Montana | 10 | 67 | 6 | 174 | 11 | 144 | 8 | 180 |
| Idaho | 19 | 19 | 24 | 26 | 30 | 31 | 28 | 43 |
| Wyoming | 16 | 21 | 36 | 10 | 21 | 63 | 22 | 80 |
| Colorado | 7 | 89 | 11 | 99 | 16 | 116 | 17 | 125 |
| New Mexico | 33 | 9 | 32 | 16 | 22 | 60 | 16 | 140 |
| Arizona | 29 | 11 | 17 | 47 | 8 | 166 | 11 | 174 |
| Utah | 20 | 16 | 18 | 47 | 19 | 86 | 19 | 109 |
| Nevada | 37 | 5 | 23 | 27 | 25 | 51 | 24 | 70 |
| Pacific: | | | | | | | | |
| Washington | 28 | 12 | 28 | 21 | 27 | 38 | 26 | 51 |
| Oregon | 39 | 4 | 37 | 8 | 40 | 6 | 38 | 11 |
| California | 9 | 76 | 7 | 162 | 7 | 313 | 4 | 421 |

[a] From census reports. The figures for 1899 are those reported for 1902. The figures for 1923 are estimated on the basis of past growth. Motors operated by purchased power are included.

TABLE 14.—*Horsepower, in thousands, of prime movers utilized in agriculture, 1869–1923, by States and geographic divisions*[a]

| Division and State | 1869 | | 1879 | | 1889 | | 1899 | | 1909 | | 1919 | | 1923 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power |
| United States | | 9,588 | | 13,764 | | 19,835 | | 23,519 | | 30,807 | | 39,222 | | 38,100 |
| New England | 6 | 614 | 8 | 632 | 8 | 595 | 8 | 470 | 9 | 462 | 9 | 471 | 9 | 549 |
| Middle Atlantic | 3 | 1,476 | 4 | 1,598 | 5 | 1,764 | 6 | 1,755 | 6 | 1,887 | 7 | 2,079 | 8 | 2,009 |
| East North Central | 1 | 2,794 | 1 | 3,660 | 2 | 4,381 | 2 | 4,937 | 2 | 5,773 | 2 | 6,870 | 2 | 6,803 |
| West North Central | 5 | 1,190 | 2 | 2,959 | 1 | 5,871 | 1 | 7,697 | 1 | 10,590 | 1 | 13,370 | 1 | 13,411 |
| South Atlantic | 2 | 1,532 | 3 | 1,748 | 3 | 2,321 | 3 | 2,615 | 4 | 3,108 | 4 | 3,763 | 4 | 3,184 |
| East South Central | 4 | 1,226 | 5 | 1,488 | 4 | 1,984 | 4 | 2,288 | 5 | 2,838 | 5 | 3,453 | 5 | 2,533 |
| West South Central | 8 | 344 | 6 | 923 | 6 | 1,647 | 5 | 2,208 | 3 | 3,717 | 3 | 4,976 | 3 | 5,089 |
| Mountain | 9 | 29 | 9 | 109 | 9 | 299 | 9 | 470 | 8 | 1,015 | 6 | 2,358 | 6 | 2,472 |
| Pacific | 7 | 383 | 7 | 647 | 7 | 973 | 7 | 1,079 | 7 | 1,417 | 8 | 1,882 | 7 | 2,050 |
| New England: | | | | | | | | | | | | | | |
| Maine | 18 | 154 | 26 | 165 | 30 | 159 | 32 | 140 | 33 | 194 | 36 | 157 | 35 | 189 |
| New Hampshire | 24 | 125 | 30 | 110 | 35 | 99 | 39 | 71 | | | | | | |
| Vermont | 19 | 153 | 27 | 165 | 31 | 159 | 35 | 117 | 35 | 132 | 38 | 126 | 40 | 127 |
| Massachusetts | 30 | 86 | 32 | 94 | 36 | 89 | 38 | 71 | 41 | 74 | 42 | 99 | 44 | 107 |
| Rhode Island | 36 | 19 | 39 | 15 | 47 | 10 | | | | | | | | |
| Connecticut | 31 | 77 | 33 | 83 | 37 | 79 | 41 | 71 | 42 | 62 | 43 | 89 | 41 | 126 |
| Middle Atlantic: | | | | | | | | | | | | | | |
| New York | 2 | 784 | 4 | 853 | 7 | 913 | 10 | 916 | 13 | 955 | 13 | 1,059 | 16 | 941 |
| New Jersey | 26 | 107 | 31 | 98 | 33 | 117 | 34 | 117 | 38 | 123 | 39 | 118 | 37 | 148 |
| Pennsylvania | 4 | 585 | 6 | 647 | 10 | 734 | 12 | 722 | 17 | 809 | 19 | 902 | 17 | 920 |
| East North Central: | | | | | | | | | | | | | | |
| Ohio | 3 | 729 | 3 | 881 | 6 | 993 | 6 | 1,079 | 9 | 1,230 | 9 | 1,450 | 10 | 1,404 |
| Indiana | 5 | 518 | 7 | 625 | 9 | 833 | 9 | 940 | 11 | 1,078 | 12 | 1,285 | 12 | 1,268 |
| Illinois | 1 | 990 | 1 | 1,315 | 1 | 1,465 | 2 | 1,579 | 3 | 1,832 | 4 | 2,096 | 4 | 2,071 |
| Michigan | 16 | 259 | 16 | 399 | 14 | 555 | 13 | 681 | 15 | 863 | 15 | 1,058 | 13 | 1,031 |
| Wisconsin | 13 | 298 | 12 | 440 | 15 | 535 | 15 | 658 | 18 | 770 | 17 | 981 | 14 | 1,029 |
| West North Central: | | | | | | | | | | | | | | |
| Minnesota | 25 | 115 | 17 | 344 | 13 | 615 | 5 | 1,079 | 8 | 1,261 | 8 | 1,675 | 8 | 1,600 |
| Iowa | 6 | 479 | 2 | 978 | 2 | 1,389 | 1 | 1,673 | 2 | 1,887 | 3 | 2,149 | 3 | 2,206 |
| Missouri | 7 | 461 | 5 | 812 | 5 | 1,090 | 4 | 1,314 | 5 | 1,601 | 5 | 2,000 | 5 | 2,032 |
| North Dakota | | | | | 26 | 258 | 20 | 541 | 7 | 1,323 | 7 | 1,921 | 7 | 1,888 |
| South Dakota | | | 36 | 41 | 21 | 397 | 17 | 624 | 12 | 1,016 | 11 | 1,311 | 11 | 1,336 |
| Nebraska | 35 | 29 | 20 | 262 | 8 | 853 | 8 | 1,056 | 6 | 1,561 | 6 | 1,921 | 6 | 1,940 |
| Kansas | 27 | 106 | 10 | 522 | 3 | 1,269 | 3 | 1,410 | 1 | 1,941 | 2 | 2,393 | 2 | 2,409 |
| South Atlantic: | | | | | | | | | | | | | | |
| Delaware | 34 | 38 | 37 | 28 | 42 | 20 | | | | | | | | |
| Maryland | 21 | 144 | 25 | 165 | 29 | 198 | 31 | 188 | 32 | 216 | 34 | 236 | 34 | 216 |
| District of Columbia | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West Virginia | [illegible] | [illegible] | 25 | 115 | 11 | 315 | 19 | 564 | 21 | 647 | 24 | 746 | 23 | 703 |
| North Carolina | 23 | 134 | 23 | 179 | 25 | 258 | 27 | 306 | 28 | 339 | 30 | 432 | 33 | 358 |
| South Carolina | 14 | 269 | 18 | 316 | 20 | 437 | 23 | 469 | 24 | 554 | 27 | 628 | 26 | 579 |
| Georgia | 20 | 153 | 22 | 193 | 23 | 298 | 26 | 329 | 26 | 401 | 29 | 471 | 30 | 419 |
| Florida | 11 | 342 | 14 | 413 | 16 | 535 | 14 | 665 | 16 | 828 | 16 | 1,054 | 19 | 779 |
| East South Central: | 33 | 38 | 35 | 41 | 38 | 60 | 36 | 94 | 37 | 123 | 35 | 196 | 38 | 130 |
| Kentucky | 9 | 408 | 9 | 525 | 12 | 655 | 11 | 785 | 14 | 928 | 14 | 1,059 | 20 | 763 |
| Tennessee | 10 | 347 | 15 | 413 | 18 | 515 | 18 | 587 | 20 | 708 | 20 | 863 | 21 | 728 |
| Alabama | 15 | 260 | 19 | 302 | 19 | 437 | 21 | 493 | 22 | 616 | 22 | 785 | 28 | 499 |
| Mississippi | 17 | 211 | 21 | 248 | 22 | 377 | 24 | 423 | 23 | 586 | 23 | 746 | 27 | 543 |
| West South Central: | | | | | | | | | | | | | | |
| Arkansas | 29 | 96 | 24 | 179 | 24 | 298 | 25 | 398 | 25 | 523 | 25 | 706 | 22 | 713 |
| Louisiana | 28 | 106 | 28 | 124 | 27 | 218 | 28 | 259 | 29 | 339 | 31 | 432 | 29 | 460 |
| Oklahoma | | | | | 41 | 40 | 22 | 493 | 10 | 1,139 | 10 | 1,410 | 9 | 1,441 |
| Texas | 22 | 142 | 8 | 620 | 4 | 1,091 | 7 | 1,058 | 4 | 1,716 | 1 | 2,428 | 1 | 2,475 |
| Mountain: | | | | | | | | | | | | | | |
| Montana | | | 40 | [illegible]14 | 39 | 60 | 37 | 94 | 31 | 246 | 21 | 863 | 18 | 858 |
| Idaho | | | 41 | 14 | 40 | 40 | 40 | 71 | 35 | 185 | 33 | 353 | 31 | 388 |
| Wyoming | | | | | 43 | 20 | 42 | 47 | 39 | 92 | 37 | 157 | 36 | 167 |
| Colorado | 37 | 19 | 34 | 53 | 32 | 119 | 33 | 139 | 33 | 215 | 26 | 671 | 25 | 626 |
| New Mexico | 38 | 10 | | | 44 | 20 | 44 | 24 | 41 | 92 | 40 | 118 | 42 | 122 |
| Arizona | | | | | | | 45 | 24 | 45 | 31 | 44 | 39 | 43 | 114 |
| Utah | | | 42 | 14 | 45 | 20 | 43 | 47 | 40 | 92 | 41 | 118 | 39 | 129 |
| Nevada | | | 43 | 14 | 46 | 20 | 46 | 24 | 44 | 62 | 45 | 39 | 45 | 68 |
| Pacific: | | | | | | | | | | | | | | |
| Washington | 39 | 10 | 38 | 28 | 34 | 99 | 29 | 211 | 27 | 401 | 28 | 549 | 24 | 654 |
| Oregon | 32 | 58 | 29 | 110 | 28 | 198 | 30 | 211 | 30 | 277 | 32 | 353 | 32 | 368 |
| California | 12 | 315 | 11 | 509 | 11 | 676 | 16 | 657 | 19 | 739 | 18 | 980 | 15 | 1,028 |

[a] Estimated on the basis of acreage of improved farm land. Purchased power and trucks not included.

TABLE 15.—*Horsepower, in thousands, of prime movers installed in irrigation and drainage, 1909–1923, by States and geographic division*[a]

| Division and State | 1909 | | 1919 | | 1923 | |
|---|---|---|---|---|---|---|
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------- | 361 | ------- | 816 | ------- | 1,300 |
| East North Central | ------- | ------- | 4 | 20 | 4 | 23 |
| West North Central | 4 | 4 | 5 | 16 | 5 | 18 |
| South Atlantic | ------- | ------- | 6 | 1 | 6 | 2 |
| West South Central | 2 | 139 | 2 | 235 | 2 | 370 |
| Mountain | 3 | 73 | 3 | 90 | 3 | 103 |
| Pacific | 1 | 145 | 1 | 454 | 1 | 784 |
| East North Central: | | | | | | |
| Indiana | ------- | ------- | 18 | 1 | 21 | 1 |
| Illinois | ------- | ------- | 8 | 18 | 9 | 20 |
| Michigan | ------- | ------- | 20 | 1 | 17 | 2 |
| West North Central: | | | | | | |
| Iowa | ------- | ------- | 15 | 3 | 15 | 4 |
| Missouri | ------- | ------- | 16 | 3 | 16 | 3 |
| North Dakota | 13 | 2 | 17 | 2 | ------- | ------- |
| South Dakota | ------- | ------- | ------- | ------- | 22 | 1 |
| Nebraska | ------- | ------- | 21 | 1 | 23 | 1 |
| Kansas | 14 | 2 | 14 | 7 | 14 | 9 |
| South Atlantic: | | | | | | |
| North Carolina | ------- | ------- | 22 | 1 | 18 | 2 |
| West South Central: | | | | | | |
| Arkansas | 7 | 12 | 4 | 61 | 4 | 90 |
| Louisiana | 3 | 58 | 2 | 93 | 2 | 150 |
| Texas | 2 | 69 | 3 | 81 | 3 | 130 |
| Mountain: | | | | | | |
| Montana | 10 | 4 | 11 | 10 | 11 | 12 |
| Idaho | 9 | 7 | 5 | 29 | 7 | 30 |
| Wyoming | 15 | 1 | 19 | 1 | 19 | 2 |
| Colorado | 8 | 8 | 12 | 9 | 12 | 10 |
| New Mexico | 5 | 14 | 13 | 8 | 13 | 10 |
| Arizona | 4 | 36 | 7 | 22 | 8 | 25 |
| Utah | 12 | 2 | 10 | 11 | 10 | 13 |
| Nevada | 16 | 1 | ------- | ------- | 20 | 1 |
| Pacific: | | | | | | |
| Washington | 6 | 14 | 6 | 23 | 5 | 60 |
| Oregon | 11 | 3 | 9 | 16 | 6 | 40 |
| California | 1 | 128 | 1 | 415 | 1 | 684 |

[a] Figures for 1909 and 1919 from census reports; for 1923 estimated on basis of past growth.

TABLE 16.—*Horsepower, in thousands, of prime movers in electric central stations, 1899–1923, by States and geographic divisions*[a]

| Division and State | 1899 | | 1909 | | 1919 | | 1923 | |
|---|---|---|---|---|---|---|---|---|
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------- | 1,200 | ------- | 5,225 | ------- | 15,250 | ------- | 22,000 |
| New England | 3 | 156 | 4 | 475 | 4 | 1,490 | 4 | 2,200 |
| Middle Atlantic | 1 | 384 | 1 | 1,420 | 1 | 4,200 | 1 | 6,010 |
| East North Central | 2 | 252 | 2 | 1,145 | 2 | 3,365 | 2 | 5,000 |
| West North Central | 5 | 100 | 5 | 410 | 6 | 1,274 | 6 | 1,700 |
| South Atlantic | 7 | 57 | 6 | 345 | 5 | 1,337 | 5 | 2,000 |
| East South Central | 8 | 38 | 9 | 147 | 8 | 604 | 8 | 740 |
| West South Central | 9 | 36 | 8 | 154 | 9 | 500 | 9 | 650 |
| Mountain | 6 | 58 | 7 | 274 | 7 | 775 | 7 | 1,100 |
| Pacific | 4 | 119 | 3 | 855 | 3 | 1,705 | 3 | 2,600 |
| New England: | | | | | | | | |
| Maine | 19 | 15 | 20 | 58 | 33 | 110 | 37 | 140 |
| New Hampshire | 12 | 25 | 21 | 55 | 38 | 80 | 40 | 84 |
| Vermont | 26 | 9 | 28 | 37 | 36 | 90 | 35 | 152 |
| Massachusetts | 5 | 80 | 6 | 220 | 5 | 800 | 6 | 1,192 |
| Rhode Island | 24 | 12 | 29 | 35 | 24 | 160 | 24 | 243 |
| Connecticut | 18 | 15 | 18 | 70 | 20 | 250 | 15 | 389 |
| Middle Atlantic: | | | | | | | | |
| New York | 1 | 226 | 1 | 870 | 1 | 2,100 | 1 | 2,930 |
| New Jersey | 7 | 40 | 8 | 130 | 9 | 400 | 10 | 520 |
| Pennsylvania | 2 | 118 | 4 | 420 | 2 | 1,700 | 2 | 2,560 |
| East North Central: | | | | | | | | |
| Ohio | 6 | 68 | 7 | 220 | 7 | 700 | 5 | 1,310 |
| Indiana | 9 | 31 | 9 | 130 | 10 | 370 | 12 | 495 |
| Illinois | 4 | 90 | 3 | 480 | 4 | 1,100 | 4 | 1,540 |
| Michigan | 8 | 40 | 5 | 230 | 6 | 745 | 7 | 1,125 |
| Wisconsin | 14 | 23 | 14 | 85 | 8 | 450 | 9 | 530 |
| West North Central: | | | | | | | | |
| Minnesota | 10 | 28 | 11 | 120 | 16 | 260 | 18 | 338 |
| Iowa | 13 | 24 | 25 | 53 | 15 | 280 | 16 | 342 |
| Missouri | 11 | 26 | 10 | 125 | 13 | 300 | 13 | 450 |
| North Dakota | 46 | 2 | 44 | 12 | 45 | 34 | 45 | 47 |
| South Dakota | 39 | 4 | 42 | 15 | 43 | 40 | 43 | 58 |
| Nebraska | 29 | 8 | 36 | 30 | 28 | 130 | 34 | 155 |
| Kansas | 30 | 8 | 22 | 55 | 21 | 230 | 21 | 310 |
| South Atlantic: | | | | | | | | |
| Delaware | 35 | 5 | 48 | 5 | 49 | 5 | 49 | 10 |
| Maryland | 21 | 14 | 26 | 52 | 30 | 120 | 22 | 300 |
| District of Columbia | ------- | ------- | ------- | ------- | 32 | 110 | 31 | 165 |
| Virginia | 40 | 4 | 35 | 30 | 29 | 120 | 29 | 180 |
| West Virginia | 31 | 7 | 37 | 28 | 19 | 250 | 19 | 330 |
| North Carolina | 36 | 5 | 31 | 35 | 22 | 230 | 23 | 250 |
| South Carolina | 27 | 9 | 12 | 120 | 14 | 300 | 11 | 500 |
| Georgia | 28 | 8 | 23 | 55 | 27 | 130 | 32 | 160 |
| Florida | 37 | 5 | 40 | 20 | 39 | 72 | 38 | 105 |
| East South Central: | | | | | | | | |
| Kentucky | 23 | 12 | 24 | 55 | 34 | 110 | 36 | 145 |
| Tennessee | 20 | 15 | 27 | 40 | 23 | 202 | 26 | 210 |
| Alabama | 34 | 6 | 32 | 32 | 18 | 250 | 20 | 320 |
| Mississippi | 38 | 5 | 39 | 20 | 42 | 42 | 41 | 65 |
| West South Central: | | | | | | | | |
| Arkansas | 32 | 7 | 41 | 18 | 41 | 42 | 42 | 60 |
| Louisiana | 33 | 6 | 38 | 24 | 44 | 38 | 44 | 50 |
| Oklahoma | 43 | 3 | 33 | 32 | 35 | 110 | 33 | 160 |
| Texas | 17 | 20 | 15 | 80 | 12 | 310 | 14 | 380 |
| Mountain: | | | | | | | | |
| Montana | 15 | 23 | 16 | 75 | 17 | 260 | 17 | 340 |
| Idaho | 41 | 4 | 34 | 30 | 31 | 115 | 25 | 230 |
| Wyoming | 44 | 3 | 47 | 7 | 46 | 32 | 46 | 44 |
| Colorado | 16 | 20 | 13 | 95 | 26 | 134 | 30 | 167 |
| New Mexico | 47 | 1 | 46 | 7 | 47 | 18 | 47 | 22 |
| Arizona | 45 | 2 | 43 | 15 | 40 | 50 | 39 | 90 |
| Utah | 42 | 4 | 30 | 35 | 25 | 150 | 27 | 190 |
| Nevada | 48 | 1 | 45 | 10 | 48 | 16 | 48 | 17 |
| Pacific: | | | | | | | | |
| Washington | 25 | 10 | 19 | 65 | 11 | 320 | 8 | 564 |
| Oregon | 22 | 14 | 17 | 70 | 37 | 85 | 28 | 180 |
| California | 3 | 95 | 2 | 720 | 3 | 1,300 | 3 | 1,856 |

[a] Based on census reports for 1902, 1907, 1912, 1917, and 1922.

TABLE 17.—*Horsepower, in thousands, of prime movers in electric railroads, 1899–1923, by States and geographic divisions* [a]

| Division and State | 1899 | | 1909 | | 1919 | | 1923 | |
|---|---|---|---|---|---|---|---|---|
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------- | 935 | ------- | 3,091 | ------- | 4,360 | ------- | 4,100 |
| New England | 3 | 130 | 3 | 386 | 4 | 489 | 4 | 463 |
| Middle Atlantic | 1 | 280 | 1 | 843 | 1 | 1,167 | 1 | 1,287 |
| East North Central | 2 | 270 | 2 | 710 | 2 | 982 | 2 | 777 |
| West North Central | 4 | 84 | 5 | 289 | 5 | 483 | 5 | 452 |
| South Atlantic | 5 | 81 | 4 | 340 | 3 | 574 | 3 | 586 |
| East South Central | 7 | 25 | 7 | 114 | 8 | 129 | 8 | 111 |
| West South Central | 8 | 16 | 8 | 85 | 7 | 188 | 6 | 218 |
| Mountain | 9 | 9 | 9 | 54 | 9 | 59 | 9 | 60 |
| Pacific | 6 | 40 | 6 | 270 | 6 | 289 | 7 | 146 |
| New England: | | | | | | | | |
| Maine | 24 | 7 | 25 | 27 | 21 | 49 | 17 | 5 |
| New Hampshire | 32 | 3 | 40 | 4 | 40 | 3 | 40 | 2 |
| Vermont | 38 | 1 | 39 | 6 | 39 | 5 | 39 | 2 |
| Massachusetts | 4 | 93 | 4 | 270 | 3 | 320 | 3 | 300 |
| Rhode Island | 26 | 6 | 23 | 33 | 20 | 52 | 20 | 47 |
| Connecticut | 11 | 20 | 19 | 46 | 16 | 60 | 18 | 55 |
| Middle Atlantic: | | | | | | | | |
| New York | 1 | 175 | 1 | 500 | 1 | 850 | 1 | 1,000 |
| New Jersey | 14 | 15 | 17 | 50 | 33 | 24 | 27 | 32 |
| Pennsylvania | 5 | 90 | 2 | 293 | 4 | 293 | 4 | 255 |
| East North Central: | | | | | | | | |
| Ohio | 3 | 96 | 3 | 290 | 2 | 560 | 2 | 386 |
| Indiana | 13 | 16 | 9 | 90 | 6 | 167 | 8 | 149 |
| Illinois | 2 | 99 | 5 | 180 | 9 | 148 | 9 | 147 |
| Michigan | 7 | 33 | 13 | 60 | 17 | 60 | 19 | 55 |
| Wisconsin | 9 | 26 | 8 | 90 | 22 | 47 | 22 | 40 |
| West North Central: | | | | | | | | |
| Minnesota | 16 | 14 | 11 | 85 | 10 | 142 | 11 | 122 |
| Iowa | 15 | 15 | 18 | 50 | 12 | 138 | 10 | 134 |
| Missouri | 6 | 50 | 7 | 120 | 7 | 165 | 7 | 162 |
| North Dakota | | | | | | | | |
| South Dakota | | | | | | | | |
| Nebraska | 33 | 3 | 31 | 19 | 30 | 27 | 29 | 27 |
| Kansas | 34 | 2 | 35 | 15 | 37 | 11 | 35 | 7 |
| South Atlantic: | | | | | | | | |
| Delaware | 28 | 4 | 33 | 17 | 28 | 32 | 23 | 35 |
| Maryland | 12 | 19 | 12 | 77 | 25 | 40 | 34 | 18 |
| District of Columbia | 20 | 8 | 30 | 21 | 34 | 22 | 31 | 23 |
| Virginia | 17 | 11 | 10 | 88 | 11 | 140 | 6 | 170 |
| West Virginia | 25 | 7 | 26 | 27 | 18 | 60 | 14 | 82 |
| North Carolina | 29 | 4 | 32 | 18 | 35 | 15 | 37 | 4 |
| South Carolina | 30 | 4 | 36 | 15 | 29 | 28 | 33 | 18 |
| Georgia | 10 | 22 | 14 | 60 | 5 | 204 | 5 | 209 |
| Florida | 35 | 2 | 34 | 17 | 27 | 33 | 26 | 32 |
| East South Central: | | | | | | | | |
| Kentucky | 18 | 10 | 27 | 27 | 24 | 42 | 21 | 44 |
| Tennessee | 27 | 6 | 20 | 44 | 23 | 44 | 24 | 38 |
| Alabama | 21 | 8 | 22 | 34 | 26 | 34 | 28 | 28 |
| Mississippi | 39 | 1 | 38 | 9 | 38 | 9 | 38 | 4 |
| West South Central: | | | | | | | | |
| Arkansas | 36 | 2 | 37 | 12 | 32 | 25 | 25 | 31 |
| Louisiana | 19 | 10 | 21 | 42 | 14 | 80 | 13 | 93 |
| Oklahoma | ------- | ------- | 41 | 4 | 36 | 15 | 32 | 18 |
| Texas | 31 | 4 | 28 | 27 | 15 | 68 | 15 | 76 |
| Mountain: | | | | | | | | |
| Montana | 40 | 1 | 42 | 1 | ------- | ------- | ------- | ------- |
| Idaho | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Wyoming | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Colorado | 22 | 8 | 24 | 30 | 19 | 59 | 16 | 60 |
| New Mexico | ------- | ------- | 43 | 1 | ------- | ------- | ------- | ------- |
| Arizona | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Utah | ------- | ------- | 29 | 22 | ------- | ------- | ------- | ------- |
| Nevada | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Pacific: | | | | | | | | |
| Washington | 23 | 8 | 6 | 160 | 8 | 150 | 30 | 2 |
| Oregon | 37 | 2 | 15 | 58 | 13 | 114 | 12 | 11 |
| California | 8 | 30 | 16 | 52 | 31 | 25 | 36 | |

[a] Based on census reports for 1902, 1907, 1912, 1917, and 1922.

TABLE 18.—*Horsepower, in thousands, of prime movers in central electric stations and electric railroads plus horsepower of electric motors driven by electricity generated in manufactures and in mines and quarries, 1899–1923, by States and geographic divisions* [a]

| Division and State | 1899 | | 1909 | | 1919 | | 1923 [b] | |
|---|---|---|---|---|---|---|---|---|
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------- | 2,575 | ------- | 11,878 | ------- | 27,839 | ------- | 34,922 |
| New England | 3 | 322 | 3 | 1,310 | 3 | 2,776 | 3 | 3,766 |
| Middle Atlantic | 1 | 827 | 1 | 3,621 | 1 | 8,467 | 1 | 10,375 |
| East North Central | 2 | 637 | 2 | 2,860 | 2 | 6,861 | 2 | 8,729 |
| West North Central | 4 | 203 | 6 | 871 | 6 | 2,138 | 6 | 2,519 |
| South Atlantic | 6 | 176 | 5 | 957 | 4 | 2,560 | 4 | 3,182 |
| East South Central | 8 | 72 | 8 | 370 | 8 | 979 | 9 | 1,003 |
| West South Central | 9 | 56 | 9 | 291 | 9 | 835 | 8 | 1,064 |
| Mountain | 7 | 100 | 7 | 415 | 7 | 1,069 | 7 | 1,285 |
| Pacific | 5 | 182 | 4 | 1,183 | 5 | 2,154 | 5 | 2,999 |
| New England: | | | | | | | | |
| Maine | 23 | 24 | 26 | 112 | 30 | 231 | 28 | 294 |
| New Hampshire | 20 | 29 | 31 | 83 | 35 | 150 | 32 | 228 |
| Vermont | 32 | 13 | 36 | 56 | 41 | 108 | 38 | 184 |
| Massachusetts | 5 | 192 | 6 | 783 | 5 | 1,544 | 5 | 2,038 |
| Rhode Island | 27 | 20 | 29 | 96 | 26 | 278 | 24 | 394 |
| Connecticut | 13 | 44 | 14 | 180 | 16 | 465 | 13 | 628 |
| Middle Atlantic: | | | | | | | | |
| New York | 1 | 435 | 1 | 1,684 | 2 | 3,471 | 2 | 4,623 |
| New Jersey | 9 | 67 | 9 | 332 | 9 | 851 | 9 | 1,058 |
| Pennsylvania | 2 | 325 | 2 | 1,605 | 1 | 4,145 | 1 | 4,694 |
| East North Central: | | | | | | | | |
| Ohio | 4 | 203 | 4 | 874 | 3 | 2,120 | 3 | 2,676 |
| Indiana | 11 | 56 | 7 | 398 | 8 | 859 | 8 | 1,234 |
| Illinois | 3 | 231 | 3 | 957 | 4 | 1,929 | 4 | 2,326 |
| Michigan | 7 | 87 | 8 | 366 | 7 | 1,191 | 7 | 1,629 |
| Wisconsin | 10 | 60 | 11 | 265 | 10 | 762 | 10 | 864 |
| West North Central: | | | | | | | | |
| Minnesota | 12 | 45 | 13 | 232 | 13 | 503 | 14 | 567 |
| Iowa | 14 | 43 | 23 | 126 | 15 | 477 | 17 | 545 |
| Missouri | 8 | 85 | 10 | 319 | 11 | 588 | 11 | 707 |
| North Dakota | 49 | 2 | 47 | 14 | 48 | 35 | 46 | 49 |
| South Dakota | 44 | 4 | 46 | 16 | 45 | 53 | 45 | 58 |
| Nebraska | 33 | 13 | 35 | 57 | 32 | 184 | 34 | 209 |
| Kansas | 34 | 11 | 28 | 107 | 24 | 298 | 25 | 384 |
| South Atlantic: | | | | | | | | |
| Delaware | 37 | 10 | 41 | 35 | 44 | 62 | 44 | 79 |
| Maryland | 16 | 36 | 18 | 158 | 22 | 323 | 19 | 468 |
| District of Columbia | 39 | 8 | 44 | 23 | 39 | 134 | 37 | 193 |
| Virginia | 25 | 22 | 19 | 158 | 21 | 346 | 20 | 445 |
| West Virginia | 17 | 31 | 15 | 167 | 14 | 497 | 18 | 540 |
| North Carolina | 35 | 11 | 33 | 79 | 23 | 309 | 26 | 333 |
| South Carolina | 28 | 19 | 16 | 161 | 20 | 365 | 15 | 565 |
| Georgia | 18 | 31 | 20 | 135 | 18 | 375 | 22 | 407 |
| Florida | 40 | 8 | 37 | 41 | 37 | 149 | 39 | 152 |
| East South Central: | | | | | | | | |
| Kentucky | 21 | 26 | 24 | 114 | 28 | 244 | 33 | 222 |
| Tennessee | 24 | 23 | 25 | 114 | 25 | 292 | 29 | 276 |
| Alabama | 29 | 17 | 27 | 108 | 19 | 371 | 21 | 418 |
| Mississippi | 42 | 6 | 42 | 34 | 43 | 72 | 43 | 87 |
| West South Central: | | | | | | | | |
| Arkansas | 36 | 11 | 39 | 37 | 42 | 84 | 42 | 110 |
| Louisiana | 30 | 17 | 30 | 84 | 34 | 162 | 36 | 202 |
| Oklahoma | 45 | 3 | 38 | 41 | 36 | 150 | 35 | 205 |
| Texas | 22 | 25 | 22 | 129 | 17 | 439 | 16 | 547 |
| Mountain: | | | | | | | | |
| Montana | 19 | 30 | 32 | 81 | 27 | 271 | 23 | 397 |
| Idaho | 41 | 6 | 40 | 35 | 40 | 128 | 31 | 241 |
| Wyoming | 43 | 4 | 49 | 9 | 47 | 38 | 47 | 49 |
| Colorado | 15 | 43 | 17 | 160 | 29 | 235 | 30 | 256 |
| New Mexico | 46 | 3 | 48 | 14 | 46 | 43 | 49 | 26 |
| Arizona | 47 | 3 | 43 | 24 | 38 | 146 | 41 | 135 |
| Utah | 38 | 9 | 34 | 74 | 33 | 176 | 40 | 150 |
| Nevada | 48 | 2 | 45 | 18 | 49 | 32 | 48 | 31 |
| Pacific: | | | | | | | | |
| Washington | 26 | 21 | 12 | 244 | 12 | 543 | 12 | 692 |
| Oregon | 31 | 17 | 21 | 135 | 31 | 225 | 27 | 296 |
| California | 6 | 144 | 5 | 804 | 6 | 1,386 | 6 | 2,011 |

[a] Figures in table represent total horsepower of all electric generators.
[b] No information available for horsepower of electric motors in mines and quarries in 1923.

TABLE 19.—*Horsepower, in thousands, of prime movers installed in ships, 1889–1923, by States and geographic divisions* [a]

| Division and State | 1889 | | 1899 | | 1909 | | 1919 | | 1923 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power | Rank | Horse-power |
| United States | ------- | 1,444 | ------- | 1,900 | ------- | 3,122 | ------- | 6,584 | ------- | 10,262 |
| New England | 3 | 211 | 4 | 193 | 4 | 250 | 6 | 279 | 6 | 557 |
| Middle Atlantic | 1 | 541 | 1 | 668 | 1 | 1,150 | 1 | 2,527 | 1 | 4,298 |
| East North Central | 2 | 321 | 2 | 500 | 2 | 790 | 3 | 1,003 | 4 | 966 |
| West North Central | 6 | 50 | 6 | 112 | 6 | 185 | 5 | 479 | 7 | 437 |
| South Atlantic | 5 | 104 | 5 | 162 | 5 | 236 | 4 | 549 | 3 | 1,499 |
| East South Central | 8 | 30 | 8 | 28 | 8 | 44 | 8 | 47 | 8 | 102 |
| West South Central | 7 | 33 | 7 | 31 | 7 | 57 | 7 | 182 | 5 | 731 |
| Mountain | ------- | ------- | 9 | 1 | ------- | ------- | ------- | ------- | ------- | ------- |
| Pacific | 4 | 154 | 3 | 205 | 3 | 410 | 2 | 1,518 | 2 | 1,672 |
| New England: | | | | | | | | | | |
| Maine | 7 | 64 | 10 | 53 | 12 | 61 | 16 | 59 | 20 | 56 |
| New Hampshire | 34 | 2 | 34 | 2 | 33 | 1 | ------- | ------- | 28 | 15 |
| Vermont | 35 | 2 | 35 | 2 | 32 | 2 | 32 | 2 | 33 | 1 |
| Massachusetts | 6 | 94 | 6 | 83 | 7 | 128 | 11 | 149 | 9 | 385 |
| Rhode Island | 17 | 16 | 21 | 15 | 22 | 16 | 24 | 17 | 23 | 33 |
| Connecticut | 11 | 33 | 12 | 38 | 15 | 42 | 17 | 52 | 18 | 67 |
| Middle Atlantic: | | | | | | | | | | |
| New York | 1 | 423 | 1 | 538 | 1 | 928 | 1 | 2,025 | 1 | 3,575 |
| New Jersey | 16 | 19 | 19 | 21 | 13 | 58 | 13 | 111 | 22 | 35 |
| Pennsylvania | 5 | 99 | 5 | 109 | 6 | 164 | 6 | 391 | 4 | 688 |
| East North Central: | | | | | | | | | | |
| Ohio | 2 | 131 | 2 | 216 | 2 | 492 | 3 | 648 | 3 | 750 |
| Indiana | 32 | 4 | 32 | 4 | 31 | 3 | 31 | 4 | 32 | 3 |
| Illinois | 14 | 25 | 13 | 35 | 14 | 45 | 15 | 63 | 19 | 59 |
| Michigan | 3 | 125 | 3 | 203 | 4 | 216 | 8 | 255 | 14 | 131 |
| Wisconsin | 10 | 36 | 11 | 42 | 17 | 34 | 20 | 33 | 24 | 23 |
| West North Central: | | | | | | | | | | |
| Minnesota | 31 | 4 | 7 | 77 | 5 | 167 | 5 | 457 | 7 | 416 |
| Iowa | 23 | 7 | 33 | 3 | 34 | 1 | 34 | 1 | 34 | 1 |
| Missouri | 9 | 38 | 14 | 31 | 23 | 16 | 23 | 19 | 27 | 18 |
| North Dakota | ------- | ------- | ------- | ------- | ------- | ------- | 33 | 2 | 35 | 1 |
| South Dakota | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Nebraska | 36 | 1 | 36 | 1 | 35 | 1 | ------- | ------- | 36 | 1 |
| Kansas | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| South Atlantic: | | | | | | | | | | |
| Delaware | 30 | 4 | 29 | 5 | 25 | 10 | 21 | 31 | 15 | 93 |
| Maryland | 8 | 45 | 8 | 70 | 9 | 83 | 10 | 186 | 5 | 599 |
| District of Columbia | 24 | 6 | 25 | 6 | 28 | 6 | 29 | 6 | 30 | 5 |
| Virginia | 20 | 11 | 20 | 19 | 10 | 62 | 9 | 223 | 6 | 509 |
| West Virginia | 25 | 5 | 26 | 6 | ------- | ------- | ------- | ------- | ------- | ------- |
| North Carolina | 29 | 4 | 30 | 4 | 26 | 8 | 26 | 12 | 21 | 37 |
| South Carolina | 26 | 5 | 27 | 5 | 29 | 6 | 27 | 9 | 26 | 19 |
| Georgia | 18 | 16 | 17 | 25 | 19 | 30 | 19 | 35 | 16 | 86 |
| Florida | 21 | 8 | 18 | 22 | 18 | 31 | 18 | 47 | 12 | 151 |
| East South Central: | | | | | | | | | | |
| Kentucky | 19 | 12 | 22 | 8 | 27 | 8 | 28 | 7 | 29 | 7 |
| Tennessee | 21 | 9 | 23 | 8 | 30 | 5 | 30 | 5 | 31 | 4 |
| Alabama | 28 | 4 | 28 | 5 | 21 | 20 | 22 | 23 | 17 | 70 |
| Mississippi | 27 | 5 | 24 | 7 | 24 | 11 | 25 | 12 | 25 | 21 |
| West South Central: | | | | | | | | | | |
| Arkansas | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Louisiana | 12 | 30 | 15 | 27 | 16 | 37 | 14 | 67 | 8 | 393 |
| Oklahoma | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Texas | 33 | 3 | 31 | 4 | 20 | 20 | 12 | 115 | 10 | 338 |
| Mountain: | | | | | | | | | | |
| Montana | ------- | ------- | 37 | 1 | ------- | ------- | ------- | ------- | ------- | ------- |
| Idaho | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Wyoming | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Colorado | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| New Mexico | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Arizona | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Utah | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Nevada | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |
| Pacific: | | | | | | | | | | |
| Washington | 15 | 20 | 9 | 63 | 8 | 123 | 4 | 540 | 13 | 143 |
| Oregon | 13 | 27 | 16 | 27 | 11 | 62 | 7 | 274 | 11 | 224 |
| California | 4 | 107 | 4 | 115 | 3 | 225 | 2 | 704 | 2 | 1,305 |

[a] Computed on the basis of tonnage figures contained in Merchant Marine Statistics (reports of the Commissioner of Navigation). See Table 30 for method of ascertaining totals.

TABLE 20.—*Horsepower, in thousands, of prime movers in motor-driven vehicles, 1919 and 1923, by States and geographic divisions* [a]

| Division and State | Total | | | | Exclusive of pleasure automobiles | | | |
|---|---|---|---|---|---|---|---|---|
| | 1919 | | 1923 | | 1919 | | 1923 | |
| | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower | Rank | Horsepower |
| United States | ------- | 230,432 | ------- | 507,254 | ------- | 10,964 | ------- | 53,724 |
| New England | 7 | 16,430 | 7 | 31,820 | 4 | 1,014 | 4 | 4,679 |
| Middle Atlantic | 3 | 37,770 | 2 | 90,678 | 2 | 2,628 | 2 | 12,100 |
| East North Central | 1 | 54,230 | 1 | 127,210 | 1 | 2,816 | 1 | 14,770 |
| West North Central | 2 | 44,590 | 3 | 80,985 | 3 | 1,342 | 3 | 6,520 |
| South Atlantic | 4 | 21,209 | 5 | 45,670 | 5 | 962 | 5 | 4,654 |
| East South Central | 9 | 8,783 | 8 | 20,367 | 8 | 416 | 8 | 2,107 |
| West South Central | 6 | 16,554 | 6 | 42,003 | 6 | 754 | 6 | 4,131 |
| Mountain | 8 | 9,736 | 9 | 16,966 | 9 | 330 | 9 | 1,685 |
| Pacific | 5 | 21,130 | 4 | 51,555 | 7 | 702 | 7 | 3,078 |
| New England: | | | | | | | | |
| Maine | 34 | 1,728 | 36 | 3,675 | 30 | 78 | 27 | 515 |
| New Hampshire | 43 | 965 | 42 | 2,075 | 35 | 52 | 41 | 230 |
| Vermont | 45 | 816 | 44 | 1,780 | 43 | 26 | 46 | 110 |
| Massachusetts | 9 | 8,140 | 10 | 16,250 | 5 | 520 | 8 | 2,400 |
| Rhode Island | 39 | 1,469 | 38 | 2,580 | 31 | 78 | 28 | 460 |
| Connecticut | 21 | 3,312 | 27 | 5,460 | 11 | 260 | 17 | 964 |
| Middle Atlantic: | | | | | | | | |
| New York | 1 | 17,250 | 1 | 40,800 | 1 | 1,768 | 1 | 6,720 |
| New Jersey | 16 | 5,820 | 14 | 14,528 | 12 | 260 | 4 | 2,930 |
| Pennsylvania | 3 | 14,700 | 7 | 35,350 | 3 | 600 | 6 | 2,450 |
| East North Central: | | | | | | | | |
| Ohio | 2 | 16,080 | 3 | 36,210 | 2 | 988 | 2 | 4,780 |
| Indiana | 13 | 6,930 | 9 | 18,700 | 8 | 364 | 7 | 2,420 |
| Illinois | 4 | 14,600 | 5 | 32,750 | 4 | 780 | 3 | 4,040 |
| Michigan | 8 | 9,410 | 6 | 24,130 | 7 | 468 | 9 | 2,400 |
| Wisconsin | 12 | 7,210 | 12 | 15,420 | 17 | 216 | 15 | 1,130 |
| West North Central: | | | | | | | | |
| Minnesota | 14 | 6,710 | 13 | 15,120 | 13 | 260 | 10 | 1,600 |
| Iowa | 6 | 11,100 | 8 | 19,300 | 9 | 312 | 14 | 1,195 |
| Missouri | 10 | 7,400 | 11 | 16,100 | 14 | 260 | 11 | 1,520 |
| North Dakota | 28 | 2,518 | 35 | 3,695 | 44 | 26 | 47 | 108 |
| South Dakota | 23 | 3,092 | 31 | 4,450 | 36 | 52 | 35 | 347 |
| Nebraska | 15 | 6,400 | 17 | 9,670 | 18 | 208 | 19 | 875 |
| Kansas | 11 | 7,370 | 15 | 12,650 | 16 | 224 | 18 | 875 |
| South Atlantic: | | | | | | | | |
| Delaware | 48 | 493 | 48 | 1,020 | 45 | 26 | 43 | 174 |
| Maryland | 24 | 2,918 | 24 | 5,730 | 20 | 156 | 32 | 383 |
| District of Columbia | 41 | 1,079 | 39 | 2,520 | 37 | 52 | 40 | 236 |
| Virginia | 25 | 2,870 | 20 | 7,400 | 19 | 182 | 16 | 1,016 |
| West Virginia | 37 | 1,530 | 28 | 5,335 | 21 | 130 | 39 | 246 |
| North Carolina | 19 | 3,510 | 19 | 8,350 | 22 | 130 | 22 | 701 |
| South Carolina | 30 | 2,439 | 32 | 4,310 | 38 | 52 | 33 | 382 |
| Georgia | 17 | 4,680 | 22 | 5,870 | 23 | 130 | 21 | 741 |
| Florida | 35 | 1,690 | 29 | 5,135 | 27 | 104 | 20 | 775 |
| East South Central: | | | | | | | | |
| Kentucky | 26 | 2,742 | 21 | 6,703 | 24 | 130 | 24 | 676 |
| Tennessee | 29 | 2,449 | 23 | 5,857 | 28 | 104 | 25 | 632 |
| Alabama | 33 | 1,794 | 33 | 4,280 | 25 | 130 | 29 | 456 |
| Mississippi | 32 | 1,798 | 37 | 3,527 | 39 | 52 | 36 | 343 |
| West South Central: | | | | | | | | |
| Arkansas | 38 | 1,505 | 34 | 3,804 | 40 | 52 | 34 | 373 |
| Louisiana | 36 | 1,554 | 30 | 4,610 | 32 | 78 | 23 | 678 |
| Oklahoma | 20 | 3,405 | 16 | 10,350 | 29 | 104 | 26 | 610 |
| Texas | 7 | 10,090 | 7 | 23,239 | 6 | 520 | 5 | 2,470 |
| Mountain: | | | | | | | | |
| Montana | 31 | 1,808 | 40 | 2,495 | 48 | 16 | 37 | 276 |
| Idaho | 40 | 1,286 | 41 | 2,105 | 41 | 52 | 44 | 171 |
| Wyoming | 46 | 651 | 46 | 1,343 | 46 | 26 | 45 | 149 |
| Colorado | 22 | 3,200 | 25 | 5,705 | 33 | 78 | 30 | 448 |
| New Mexico | 47 | 551 | 47 | 1,117 | 47 | 18 | 48 | 99 |
| Arizona | 44 | 883 | 45 | 1,661 | 42 | 52 | 42 | 216 |
| Utah | 42 | 1,073 | 43 | 2,010 | 34 | 78 | 38 | 260 |
| Nevada | 49 | 284 | 49 | 530 | 49 | 10 | 49 | 66 |
| Pacific: | | | | | | | | |
| Washington | 18 | 4,640 | 18 | 8,740 | 15 | 260 | 13 | 1,220 |
| Oregon | 27 | 2,540 | 26 | 5,605 | 26 | 130 | 31 | 428 |
| California | 5 | 13,950 | 2 | 37,210 | 10 | 312 | 12 | 1,430 |

[a] Based on registration figures by States from reports of National Automobile Chamber of Commerce. Automobiles, motor cycles, and trucks are included. See Table 33 for average horsepower of automobiles.

TABLE 21.—*Index numbers of horsepower of prime movers, number of wage earners, and volume of production, 1889–1919, by special groups*

[1899=100]

| | Horsepower of prime movers | | | | Number of wage earners [a] | | | | Volume of production [b] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1889 | 1899 | 1909 | 1919 | 1889 | 1899 | 1909 | 1919 | 1889 | 1899 | 1909 | 1919 |
| All commodities [c] | 75 | 100 | 176 | 265 | 81 | 100 | 126 | 133 | 73 | 100 | 140 | 190 |
| "Manufactures" | [d] 56 | 100 | 195 | 282 | 80 | 100 | 125 | 170 | 75 | 100 | 150 | 220 |
| "Materials" | [d] 80 | 100 | 136 | 193 | 81 | 100 | 123 | 108 | 72 | 100 | 125 | 145 |
| Steam railroads | [e] 78 | 100 | 217 | 346 | 81 | 100 | 162 | 206 | 67 | 100 | 190 | 306 |
| Agriculture | [e] 84 | 100 | 132 | 186 | 82 | 100 | 120 | 104 | 75 | 100 | 122 | 137 |
| Mines and quarries | [e] 45 | 100 | 161 | 234 | 62 | 100 | 156 | 176 | 60 | 100 | 183 | 260 |

| | Horsepower per wage earner [f] | | | | Production per wage earner [g] | | | |
|---|---|---|---|---|---|---|---|---|
| | 1889 | 1899 | 1909 | 1919 | 1889 | 1899 | 1909 | 1919 |
| All commodities | 92 | 100 | 140 | 199 | 90 | 100 | 111 | 143 |
| "Manufactures" | 69 | 100 | 155 | 164 | 94 | 100 | 120 | 129 |
| "Materials" | 98 | 100 | 111 | 179 | 89 | 100 | 102 | 134 |
| Steam railroads | 97 | 100 | 134 | 168 | 83 | 100 | 117 | 149 |
| Agriculture | 101 | 100 | 110 | 179 | 92 | 100 | 102 | 132 |
| Mines and quarries | 73 | 100 | 103 | 133 | 97 | 100 | 117 | 148 |

[a] Table 7.
[b] Stewart, W. W., Am. Econ. Review, March, 1920, p. 57. Figures represent five-year averages.
[c] Comprise "manufactures," "materials," and "transportation." See footnotes to Table 6 for definitions of these groups.
[d] Table 6.
[e] Table 3.
[f] Table 8.
[g] Ratio of index numbers of volume of production to index numbers of number of wage earners.

TABLE 22.—*Index numbers of total horsepower of prime movers and acreage of improved land, 1849–1923*

[1899=100]

| Year | Horsepower of prime movers | | Acreage of improved land [a] |
|---|---|---|---|
| | Total | Exclusive of pleasure automobiles | |
| 1849 | 16 | ---- | 27 |
| 1859 | 25 | ---- | 39 |
| 1869 | 30 | ---- | 46 |
| 1879 | 45 | ---- | 69 |
| 1889 | 74 | ---- | 86 |
| 1899 | 100 | 100 | 100 |
| 1909 | 188 | 176 | 115 |
| 1919 | 617 | 275 | 122 |
| 1923 | 1,065 | 359 | ---- |

[a] Census reports.

TABLE 23.—*Horsepower, in thousands, of prime movers utilized in manufactures, 1849–1923* [a]

| Year | Total horsepower | Owned | | | | Driven by purchased power | | | Electric motors | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Steam engines and turbines | Internal-combustion engines | Water wheels | Total | Electric motors | Other | Total | Driven by | |
| | | | | | | | | | | Purchased power | Owned power |
| 1849 [b] | 1,100 | 1,100 | 450 | | 650 | | | | | | |
| 1859 [b] | 1,600 | 1,600 | 700 | | 900 | | | | | | |
| 1869 | 2,346 | 2,346 | 1,216 | | 1,130 | (c) | | | | | |
| 1879 | 3,411 | 3,411 | 2,185 | | 1,226 | (c) | | | | | |
| 1889 | 5,939 | 5,850 | 4,586 | 9 | 1,255 | 89 | (c) | 89 | 16 | (c) | |
| 1899 | 10,098 | 9,778 | 8,190 | 134 | 1,454 | 320 | 182 | 137 | 493 | 182 | 311 |
| 1909 | 18,675 | 16,803 | 14,229 | 751 | 1,823 | 1,872 | 1,749 | 123 | 4,817 | 1,749 | 3,068 |
| 1919 | 29,505 | 20,063 | 17,038 | 1,259 | 1,765 | 9,442 | 9,348 | 94 | 16,317 | 9,348 | 6,969 |
| 1923 | 33,094 | 19,729 | 16,701 | 1,224 | 1,803 | 13,365 | 13,365 | (d) | 22,187 | 13,365 | 8,822 |

[a] Census reports.
[b] Estimated.
[c] Figures not available.
[d] Not reported.

TABLE 24.—*Horsepower, in thousands, of prime movers utilized in mines and quarries, 1849–1923* [a]

| Year | Total horsepower | Owned | | | | Driven by purchased power | | | Electric motors | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Steam engines and turbines | Internal-combustion engines | Water wheels | Total | Electric motors | Other | Total | Driven by | |
| | | | | | | | | | | Purchased power | Owned power |
| 1849 [b] | 50 | 50 | 38 | | 12 | | | | | | |
| 1859 [b] | 150 | 150 | 120 | | 30 | | | | | | |
| 1869 [b] | 350 | 350 | 275 | | 75 | | | | | | |
| 1879 [b] | 650 | 650 | 525 | | 125 | | | | | | |
| 1889 [b] | 1,300 | 1,300 | 1,050 | | 250 | | | | | | |
| 1899 | 2,868 | 2,754 | 2,433 | 260 | 61 | 114 | 114 | | 114 | 114 | |
| 1909 | 4,608 | 4,403 | 3,787 | 519 | 97 | 206 | 206 | | 700 | 206 | 494 |
| 1919 | 6,724 | 5,112 | 3,713 | 1,361 | 38 | 1,612 | 1,603 | 9 | 2,862 | 1,603 | 1,259 |
| 1923 [c] | 7,500 | 5,000 | 3,275 | 1,700 | 25 | 2,500 | 2,500 | | 2,500 | 2,500 | |

[a] Census reports.
[b] Estimated from data in census reports.
[c] Estimated.

TABLE 25.—*Horsepower, in thousands, of prime movers utilized in agriculture, 1849–1923* [a]

| Year | Oxen | Mules | Horses | Total animals | Windmills | Steam engines | Stationary gas engines | Electric motors | Gas tractors | Trucks | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1849 | 1,701 | 559 | 4,337 | 6,597 | | | | | | | 6,597 |
| 1859 | 2,255 | 1,151 | 6,249 | 9,655 | | | | | | | 9,655 |
| 1869 | 1,317 | 1,125 | 7,146 | 9,588 | | | | | | | 9,588 |
| 1879 | 994 | 1,812 | 10,358 | 13,164 | 100 | 500 | | | | | 13,764 |
| 1889 | 1,117 | 2,252 | 15,267 | 18,636 | 200 | 1,000 | | | | | 19,836 |
| 1899 | 960 | 2,753 | 15,506 | 19,219 | 300 | 3,500 | 500 | | | | 23,519 |
| 1909 | 640 | 3,787 | 17,430 | 21,857 | 450 | 4,500 | 3,500 | 300 | 500 | | 31,107 |
| 1919 | 370 | 4,652 | 17,220 | 22,242 | 480 | 3,500 | 7,000 | 1,500 | 6,000 | 3,000 | 43,722 |
| 1923 | 100 | 3,700 | 16,000 | 19,800 | 500 | 3,000 | 6,800 | 2,200 | 8,000 | 7,120 | 47,420 |

[a] C. D. Kinsman, U. S. Dept. Agriculture.

TABLE 26.—*Approximate number, in thousands, of draft animals in the United States, 1849–1923* [a]

| Year | Grand total | On farms | | | | Not on farms | | |
|---|---|---|---|---|---|---|---|---|
| | | Total | Oxen | Mules | Horses | Total | Mules | Horses |
| 1849 | 7,747 | 6,597 | 1,701 | 559 | 4,337 | 1,150 | 100 | 1,050 |
| 1859 | 10,961 | 9,655 | 2,255 | 1,151 | 6,249 | 1,306 | 120 | 1,186 |
| 1869 | 11,275 | 9,588 | 1,317 | 1,125 | 7,146 | 1,687 | 140 | 1,547 |
| 1879 | 15,324 | 13,164 | 994 | 1,812 | 10,358 | 2,160 | 160 | 2,000 |
| 1889 | 21,311 | 18,636 | 1,117 | 2,252 | 15,267 | 2,675 | 175 | 2,500 |
| 1899 | 22,274 | 19,219 | 960 | 2,753 | 15,506 | 3,055 | 182 | 2,873 |
| 1909 | 25,262 | 21,857 | 640 | 3,787 | 17,430 | 3,405 | 269 | 3,136 |
| 1919 | 24,221 | 22,242 | 370 | 4,652 | 17,220 | 1,979 | 344 | 1,635 |
| 1923 [b] | 21,500 | 19,800 | 100 | 3,700 | 16,000 | 1,700 | 400 | 1,300 |

[a] C. D. Kinsman, U. S. Dept. Agriculture. [b] Estimated.

TABLE 27.—*Horsepower, in thousands, of prime movers in central stations and electric railroads, 1889–1923* [a]

| Year | Electric central stations | | | | Electric railroads | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Steam engines and turbines | Internal-combustion engines | Water wheels | Total | Steam engines and turbines | Internal-combustion engines | Water wheels |
| 1889 | 120 | 120 | ---------- | ---------- | 140 | 140 | ---------- | ---------- |
| 1899 | 1,200 | 950 | ---------- | 250 | 935 | 900 | ---------- | 35 |
| 1909 | 5,225 | 3,450 | 75 | 1,700 | 3,091 | 2,850 | 21 | 220 |
| 1919 | 15,250 | 10,100 | 250 | 4,900 | 4,360 | 3,800 | 30 | 530 |
| 1923 | 22,000 | 15,000 | 350 | 6,650 | 4,100 | 3,650 | 30 | 420 |

[a] Based on census of electrical industries for 1902, 1907, 1912, 1917, and 1922.

TABLE 28.—*Horsepower, in thousands, of prime movers utilized in irrigation and drainage, 1879–1923* [a]

| Year | Total | Steam engines and turbines | Internal-combustion engines | Water wheels | Year | Total | Steam engines and turbines | Internal-combustion engines | Water wheels |
|---|---|---|---|---|---|---|---|---|---|
| 1879 | 5 | 2.5 | ---------- | 2.5 | 1909 | 361 | 90 | 90 | 181 |
| 1889 | 33 | 8 | 8 | 17 | 1919 | 816 | 200 | 200 | 416 |
| 1899 | 120 | 30 | 30 | 60 | 1923 | 1,300 | 300 | 300 | 700 |

[a] Data for 1879, 1889, and 1923 estimated; for other years from census reports. Division among different types of prime movers was estimated.

TABLE 29.—*Horsepower of locomotives of steam railroads, 1849–1923*

| Year | Horsepower [a] | Tractive force (pounds) | | Number of locomotives [d] | Miles of track [e] |
|---|---|---|---|---|---|
| | | Total [b] | Average per locomotive [c] | | |
| 1849 | 435,000 | 14,850,000 | 8,250 | 1,800 | 9,021 |
| 1859 | 1,940,000 | 66,400,000 | 10,850 | 6,120 | 30,635 |
| 1869 | 4,100,000 | 139,600,000 | 13,200 | 10,580 | 52,914 |
| 1879 | 7,720,000 | 263,000,000 | 15,600 | 17,084 | 86,497 |
| 1889 | 16,300,000 | 555,000,000 | 17,900 | 31,062 | 161,397 |
| 1899 | 20,900,000 | 712,000,000 | 19,443 | 36,703 | 190,818 |
| 1909 | 45,400,000 | 1,548,000,000 | 26,601 | 58,219 | 235,402 |
| 1919 | 72,300,000 | 2,462,000,000 | 35,789 | 68,977 | 256,572 |
| 1923 | 74,600,000 | 2,544,000,000 | 39,177 | 64,939 | |

[a] Derived from "Tractive force" by the following formula furnished by the bureau of locomotive inspection, Interstate Commerce Commission: $\frac{T \times V}{375}$ = horsepower, where T = tractive force and V = average speed in miles per hour.

[b] Result of multiplying "average per locomotive" by number of locomotives for each year.

[c] Data for 1909, 1919, and 1923 from statistical reports of Interstate Commerce Commission. Other figures are estimated from dimensions of representative locomotives (found in histories of locomotives), as applied to the Baltimore locomotive formula for tractive force: $T = \frac{C^2SP}{D}$, where C = diameter of cylinder in inches, S = stroke of pistion in inches, P = mean effective boiler pressure in pounds, and D = diameter of driving wheel in inches.

[d] Data for 1879 and 1889 in Poor's "Manual of railroads"; for 1899, 1909, 1919, and 1923 in statistical reports of Interstate Commerce Commission. Figures for 1849, 1859, and 1869 obtained by applying factor 0.20 to miles of railroad. This factor was selected as representative for those years, after factors for available data had been worked out.

[e] Poor's "Manual of railroads."

TABLE 30.—*Horsepower, in thousands, of prime movers in ships, 1849–1923* [a]

| Year | Total horsepower | Steam engines and turbines | | Internal-combustion engines [b] | | Wind (sail) [c] | |
|---|---|---|---|---|---|---|---|
| | | Tonnage | Horsepower | Tonnage | Horsepower | Tonnage | Horsepower |
| 1849 | 734 | 526 | [d] 305 | | | 3,010 | 429 |
| 1859 | 1,142 | 868 | [d] 503 | | | 4,486 | 639 |
| 1869 | 1,076 | 1,075 | [d] 624 | | | 3,171 | 452 |
| 1879 | 1,110 | 1,212 | [d] 703 | | | 2,856 | 407 |
| 1889 | 1,444 | 1,859 | [d] 1,078 | | | 2,566 | 366 |
| 1899 | 1,900 | 2,658 | [d] 1,542 | | | 2,507 | 358 |
| 1909 | 3,122 | 4,741 | [d] 2,750 | | | 2,608 | 372 |
| 1919 | 6,584 | 10,059 | [e] 5,734 | 356 | [f] 494 | 2,492 | 356 |
| 1923 | 10,262 | 15,358 | [e] 9,247 | 464 | [f] 664 | 2,463 | 351 |

[a] Data obtained from annual "List of merchant vessels of the United States" and from "Merchant marine statistics of 1924" issued by the Bureau of Navigation.

[b] Internal-combustion engines in ships not separable from total before 1915.

[c] Estimated, by assuming 4 tons in a sailing vessel equivalent to 1 ton in a steam vessel and applying the appropriate factor.

[d] Estimated, by assuming 0.58 horsepower per gross ton, the ratio found for steam vessels in 1910.

[e] Estimated, by assuming 0.57 horsepower per gross ton, the ratio found for steam, vessels in 1920.

[f] Estimated, by assuming 1.39 horsepower per gross ton, the ratio found for "gas" vessels in 1920.

TABLE 31.—*Horsepower, in thousands, of prime movers of motor-driven vehicles (automobiles), 1899–1923* [a]

**Horsepower**

| Year | Passenger cars | | | Trucks | Motor cycles | Total |
|---|---|---|---|---|---|---|
| | Fords [a] | All others | Total | | | |
| 1899 | | | 32 | | | 32 |
| 1909 | 2,969 | 4,454 | 7,423 | 256 | 35 | 7,714 |
| 1919 | 69,027 | 148,393 | 217,420 | 10,964 | 2,048 | 230,432 |
| 1923 | 132,932 | 319,056 | 451,988 | 53,724 | 1,542 | 507,254 |

**Index numbers (1899=100)**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1899 | | | 100 | | | 100 |
| 1909 | | | 23,200 | | | 24,100 |
| 1919 | | | 679,000 | | | 721,000 |
| 1923 | | | 1,412,000 | | | 1,585,000 |

**Index numbers (1909=100)**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1899 | | | 4 | | | 4 |
| 1909 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1919 | 2,325 | 3,332 | 2,929 | 4,283 | 5,851 | 2,987 |
| 1923 | 4,477 | 7,163 | 60,892 | 20,986 | 4,206 | 65,758 |

[a] Horsepower of a Ford considered 20. Half of passenger cars registered considered to be Fords. Average horsepower of all other passenger cars and trucks given in Table 33.

TABLE 32.—*Number of automobiles registered, 1899–1923* [a]

**Total**

| Year | Passenger cars | | | Trucks | Motor cycles | Total |
|---|---|---|---|---|---|---|
| | Fords [a] | All others | Total | | | |
| 1899 | | | 3,200 | | | 3,200 |
| 1909 | 148,450 | 148,450 | 296,900 | [b] 13,500 | [b] 7,000 | [b] 317,400 |
| 1919 | 3,451,358 | 3,451,358 | 6,902,716 | 421,692 | 241,038 | 7,565,446 |
| 1923 | 6,646,618 | 6,646,618 | 13,293,236 | 1,627,569 | 171,372 | 15,092,177 |

**Index numbers (1899=100)**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1899 | | | 100 | | | 100 |
| 1909 | | | 9,278 | | | 9,919 |
| 1919 | | | 215,709 | | | 236,419 |
| 1923 | | | 415,412 | | | 471,631 |

**Index numbers (1909=100)**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1899 | | | 1 | | | 1 |
| 1909 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1919 | 2,325 | 2,325 | 2,325 | 3,124 | 3,443 | 2,384 |
| 1923 | 4,477 | 4,477 | 4,477 | 12,056 | 2,448 | 4,755 |

[a] Registration figures as given in annual reports of National Automobile Chamber of Commerce.
[b] Proportion of trucks and motor cycles estimated from registration in 1914 and subsequent years.

TABLE 33.—*Average horsepower used in determining total horsepower of automobile engines in 1909, 1919, and 1923* [a]

| | 1909 | 1919 | 1923 |
|---|---|---|---|
| Passenger cars, other than Fords [b] | 30 | 43 | 48 |
| Trucks | 19 | 26 | 33 |
| Motorcycles | 5 | 8.5 | 9.0 |

[a] Based on actual or brake horsepower of automobile engines as furnished by the different automobile manufacturers compared with similar figures published in the January numbers of "Motor." The average horsepower of the engines of passenger cars for the different years was obtained by arranging the different makes of automobiles in groups according to volume of production. The average horsepower of each group was obtained, and the average of the groups for each year was then found by weighting the average of each group according to volume of production of all the makes included in the group. The average horsepower of trucks is the average of the horsepower of the engines of the different makes of trucks.
[b] See Table 31.

TABLE 34.—*Number of wage earners and horsepower of prime movers in certain industrial establishments not included in census totals for manufactures, 1909 and 1919* [a]

| | 1909 | | | 1919 | | |
|---|---|---|---|---|---|---|
| | Number of establishments | Number of wage earners | Horsepower | Number of establishments | Number of wage earners | Horsepower |
| Governmental manufacturing establishments | 40 | 32,519 | 47,787 | 83 | 106,763 | 172,998 |
| Power laundries | 5,186 | 109,484 | 123,477 | 5,678 | 131,879 | 196,793 |
| Dyeing and cleaning | | | | 2,156 | 18,807 | 23,946 |
| Custom sawmills | 4,133 | 7,090 | 93,280 | 5,396 | 3,175 | 130,916 |
| Custom gristmills | 11,961 | 7,014 | 272,763 | 10,427 | 2,134 | 218,894 |

[a] Census of manufactures, 1920.

TABLE 35.—*Horsepower of prime movers of municipal water-supply plants of certain cities for 1926* [a]

| City | Population (estimated) | Horsepower | | | | |
|---|---|---|---|---|---|---|
| | | Total | Steam engines | Internal-combustion engines | Water wheels | Electric motors driven by purchased power |
| Baltimore | 734,000 | 9,070 | 2,725 | | 200 | 6,145 |
| Boston | 748,000 | 5,847 | 5,847 | | | |
| Chicago | 2,702,000 | 18,160 | 18,160 | | | |
| Kansas City | 324,000 | 6,200 | 6,200 | | | |
| Minneapolis | 381,000 | 11,600 | 1,400 | | | 10,200 |
| New Orleans | 387,000 | 19,880 | 19,880 | | | |
| New York | 5,620,000 | 37,945 | 21,300 | 525 | | 16,120 |
| Pittsburgh | 588,000 | 10,462 | 10,462 | | | |
| St. Louis | 773,000 | 12,540 | 12,540 | | | |
| Seattle | 315,000 | 1,980 | | | 180 | 1,800 |
| | 12,572,000 | 133,684 | 98,514 | 525 | 380 | 34,265 |

[a] On the basis of this table, with an estimated urban population for the United States of 65,700,000 in 1926, the horsepower of prime movers in all municipal water-supply plants in the United States was about 700,000.

TABLE 36.—*Horsepower of prime movers of aircraft of the Army and Navy and of the ships of the Navy*

| Craft | Horsepower | Craft | Horsepower |
|---|---|---|---|
| Battleships | 555,131 | Submarines | 184,920 |
| Cruisers | 1,362,517 | Aircraft (Navy) [a] | 236,960 |
| Mine layers | 423,731 | Aircraft (Army) [b] | 475,185 |
| Destroyers | 7,199,868 | District craft | 45,866 |
| Auxiliaries | 526,305 | | |
| Aircraft carriers | 367,152 | | 11,560,570 |
| Patrol vessels | 182,935 | | |

[a] Compiled from "Ships' data, U. S. naval vessels, July 1, 1924," U. S. Navy Department.
[b] Annual report of the Chief of Air Service, 1925.

TABLE 37.—*Prime movers utilized in manufactures in the United Stated in 1923, by geographic divisions and States*[a]

| Division and State | Number of establishments reporting power | Prime movers | | | | | | | | | Electric motors driven by current generated in establishments reporting | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total primary horsepower[b] | Steam engines and turbines | | Internal-combustion engines | | Water wheels | | Electric motors driven by purchased current | | | |
| | | | Number | Horsepower | Number | Horsepower | Number | Horsepower | Number | Horsepower | Number | Horsepower |
| United States | 173,475 | 33,094,228 | 90,057 | 16,700,993 | 15,721 | 1,224,262 | 9,293 | 1,803,310 | 1,445,003 | 13,365,663 | 616,422 | 8,821,551 |
| New England | 17,531 | 4,151,136 | 7,593 | 1,777,813 | 784 | 46,933 | 3,454 | 761,211 | 179,192 | 1,565,179 | 97,791 | 1,102,422 |
| Middle Atlantic | 58,433 | 9,627,808 | 23,430 | 5,279,302 | 3,592 | 400,768 | 2,397 | 388,503 | 470,296 | 3,559,235 | 221,661 | 3,077,216 |
| East North Central | 37,274 | 9,061,680 | 20,641 | 4,568,174 | 4,530 | 447,735 | 1,491 | 238,676 | 391,343 | 3,807,095 | 195,502 | 2,951,857 |
| West North Central | 15,070 | 1,714,030 | 5,770 | 768,857 | 1,363 | 88,045 | 316 | 73,346 | 91,105 | 783,782 | 25,752 | 368,045 |
| South Atlantic | 14,922 | 3,143,936 | 12,502 | 1,475,792 | 2,012 | 83,603 | 1,017 | 258,558 | 131,464 | 1,325,983 | 41,181 | 596,193 |
| East South Central | 7,017 | 1,461,604 | 6,353 | 886,286 | 856 | 20,138 | 202 | 16,542 | 39,629 | 538,638 | 7,667 | 151,746 |
| West South Central | 7,223 | 1,269,347 | 6,591 | 838,409 | 1,396 | 85,942 | 76 | 7,170 | 29,186 | 337,826 | 8,673 | 195,707 |
| Mountain | 3,476 | 777,745 | 2,066 | 357,247 | 353 | 23,192 | 107 | 9,212 | 21,094 | 388,094 | 5,808 | 125,329 |
| Pacific | 12,529 | 1,886,942 | 5,111 | 749,113 | 835 | 27,906 | 233 | 50,092 | 91,694 | 1,059,831 | 12,387 | 253,036 |
| New England: | | | | | | | | | | | | |
| Maine | 1,519 | 570,532 | 1,171 | 162,546 | 134 | 6,439 | 645 | 263,705 | 10,157 | 137,842 | 5,373 | 91,730 |
| New Hampshire | 1,029 | 352,656 | 649 | 144,670 | 57 | 3,437 | 503 | 154,056 | 8,568 | 50,493 | 8,611 | 146,901 |
| Vermont | 951 | 177,212 | 467 | 47,839 | 67 | 1,167 | 395 | 64,691 | 5,370 | 63,515 | 2,203 | 29,889 |
| Massachusetts | 9,639 | 1,931,787 | 3,312 | 925,490 | 335 | 16,827 | 1,196 | 189,105 | 99,734 | 800,365 | 50,810 | 546,225 |
| Rhode Island | 1,513 | 391,928 | 586 | 187,655 | 50 | 12,184 | 198 | 27,201 | 20,733 | 164,888 | 12,813 | 103,746 |
| Connecticut | 2,880 | 727,021 | 1,408 | 309,613 | 141 | 6,879 | 517 | 62,453 | 34,630 | 348,076 | 17,981 | 183,931 |
| Middle Atlantic: | | | | | | | | | | | | |
| New York | 33,606 | 3,263,325 | 7,524 | 1,242,198 | 1,358 | 118,437 | 1,363 | 348,818 | 239,855 | 1,553,872 | 73,162 | 692,478 |
| New Jersey | 7,935 | 1,256,890 | 3,938 | 784,046 | 803 | 35,028 | 188 | 10,786 | 58,186 | 427,030 | 46,398 | 505,600 |
| Pennsylvania | 16,892 | 5,107,593 | 11,968 | 3,253,058 | 1,431 | 247,303 | 846 | 28,899 | 172,255 | 1,578,333 | 102,101 | 1,879,138 |
| East North Central: | | | | | | | | | | | | |
| Ohio | 10,255 | 3,307,726 | 6,166 | 1,843,209 | 1,279 | 141,079 | 186 | 12,478 | 119,536 | 1,310,960 | 48,858 | 980,219 |
| Indiana | 4,573 | 1,372,007 | 2,795 | 685,602 | 427 | 168,620 | 115 | 8,588 | 49,849 | 509,197 | 21,630 | 589,756 |
| Illinois | 12,250 | 1,980,508 | 4,581 | 944,945 | 616 | 76,473 | 162 | 10,028 | 111,679 | 949,062 | 48,307 | 638,524 |
| Michigan | 5,296 | 1,471,550 | 2,970 | 672,469 | 366 | 45,540 | 308 | 42,717 | 73,504 | 710,824 | 53,474 | 449,356 |
| Wisconsin | 4,900 | 929,889 | 4,129 | 421,949 | 1,842 | 16,023 | 720 | 164,865 | 36,775 | 327,052 | 23,233 | 294,002 |
| West North Central: | | | | | | | | | | | | |
| Minnesota | 3,561 | 460,128 | 1,536 | 207,348 | 196 | 19,185 | 138 | 62,944 | 21,130 | 170,651 | 5,731 | 107,072 |
| Iowa | 3,155 | 282,333 | 1,010 | 124,806 | 220 | 4,784 | 50 | 1,889 | 17,502 | 150,854 | 4,911 | 68,672 |
| Missouri | 4,681 | 553,397 | 1,928 | 231,648 | 425 | 20,728 | 47 | 1,900 | 34,183 | 299,121 | 9,366 | 95,236 |
| North Dakota | 309 | 16,730 | 84 | 10,396 | 53 | 1,775 | 5 | 91 | 1,052 | 4,468 | 136 | 1,943 |
| South Dakota | 450 | 16,458 | 130 | 5,841 | 58 | 1,102 | 6 | 293 | 1,754 | 9,222 | 37 | 384 |
| Nebraska | 1,247 | 129,429 | 303 | 53,551 | 144 | 15,417 | 38 | 3,109 | 6,886 | 57,352 | 2,133 | 27,327 |
| Kansas | 1,667 | 255,555 | 779 | 135,267 | 267 | 25,054 | 32 | 3,120 | 8,598 | 92,114 | 3,438 | 67,411 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Atlantic: | | | | | | | | | | | | |
| Delaware | 419 | 112,485 | 529 | 68,012 | 50 | 1,306 | 43 | 1,846 | 2,525 | 41,321 | 2,085 | 33,539 |
| Maryland | 2,594 | 497,945 | 1,556 | 170,645 | 349 | 10,901 | 97 | 5,625 | 23,420 | 310,774 | 6,212 | 153,358 |
| District of Columbia | 448 | 31,846 | 105 | 11,353 | 47 | 894 | 3 | 970 | 2,907 | 18,629 | 301 | 3,469 |
| Virginia | 2,579 | 431,237 | 2,060 | 230,070 | 272 | 11,027 | 388 | 47,243 | 28,147 | 142,897 | 14,745 | 95,243 |
| West Virginia | 1,371 | 371,699 | 1,131 | 217,580 | 385 | 35,681 | 56 | 4,735 | 9,055 | 113,703 | 5,603 | 128,012 |
| North Carolina | 2,587 | 702,832 | 2,113 | 245,479 | 205 | 5,939 | 247 | 146,812 | 32,047 | 304,602 | 7,936 | 79,252 |
| South Carolina | 1,121 | 407,735 | 1,021 | 195,961 | 117 | 7,493 | 90 | 28,297 | 15,169 | 175,984 | 1,549 | 49,528 |
| Georgia | 2,498 | 449,888 | 2,831 | 229,969 | 263 | 3,610 | 88 | 22,878 | 15,024 | 193,431 | 1,955 | 39,009 |
| Florida | 1,305 | 138,269 | 1,156 | 106,723 | 324 | 6,752 | 5 | 152 | 3,170 | 24,642 | 795 | 14,783 |
| East South Central: | | | | | | | | | | | | |
| Kentucky | 1,829 | 251,554 | 1,040 | 116,041 | 248 | 7,049 | 61 | 2,471 | 10,492 | 125,993 | 2,277 | 32,613 |
| Tennessee | 2,171 | 391,465 | 1,872 | 220,832 | 177 | 4,386 | 118 | 4,162 | 14,785 | 162,085 | 2,747 | 30,968 |
| Alabama | 1,841 | 640,892 | 1,960 | 396,134 | 238 | 3,291 | 13 | 9,505 | 12,398 | 231,962 | 1,800 | 69,699 |
| Mississippi | 1,176 | 177,693 | 1,481 | 153,279 | 193 | 5,412 | 10 | 404 | 1,954 | 18,598 | 843 | 18,466 |
| West South Central: | | | | | | | | | | | | |
| Arkansas | 1,183 | 165,154 | 1,396 | 134,415 | 158 | 6,045 | 10 | 361 | 2,716 | 24,333 | 846 | 15,439 |
| Louisiana | 1,594 | 402,938 | 2,632 | 334,033 | 333 | 16,893 | 23 | 325 | 5,324 | 51,687 | 2,463 | 56,841 |
| Oklahoma | 1,132 | 152,956 | 590 | 84,485 | 298 | 18,679 | 20 | 210 | 5,325 | 49,582 | 1,293 | 26,674 |
| Texas | 3,314 | 548,299 | 1,973 | 285,476 | 607 | 44,325 | 23 | 6,274 | 15,821 | 212,224 | 4,071 | 96,753 |
| Mountain: | | | | | | | | | | | | |
| Montana | 599 | 190,516 | 234 | 30,100 | 52 | 1,466 | 13 | 4,511 | 3,587 | 154,439 | 271 | 6,874 |
| Idaho | 479 | 72,146 | 347 | 46,727 | 49 | 1,714 | 10 | 429 | 1,940 | 23,276 | 383 | 11,064 |
| Wyoming | 215 | 23,959 | 123 | 14,049 | 49 | 1,893 | 3 | 98 | 961 | 7,919 | 282 | 5,107 |
| Colorado | 1,146 | 176,076 | 624 | 109,333 | 99 | 2,146 | 14 | 666 | 6,529 | 63,931 | 1,870 | 28,846 |
| New Mexico | 170 | 16,863 | 123 | 13,212 | 21 | 963 | 4 | 310 | 394 | 2,378 | 256 | 4,033 |
| Arizona | 253 | 128,531 | 202 | 85,339 | 40 | 13,568 | 1 | 60 | 1,524 | 29,564 | 1,390 | 45,078 |
| Utah | 519 | 141,671 | 373 | 38,166 | 23 | 505 | 58 | 2,508 | 5,764 | 100,492 | 1,063 | 10,093 |
| Nevada | 95 | 27,983 | 40 | 20,321 | 20 | 937 | 4 | 630 | 395 | 6,095 | 293 | 14,234 |
| Pacific: | | | | | | | | | | | | |
| Washington | 2,698 | 593,330 | 2,174 | 359,420 | 235 | 10,498 | 47 | 6,211 | 14,501 | 217,201 | 4,827 | 103,211 |
| Oregon | 1,692 | 322,297 | 1,118 | 169,765 | 110 | 1,657 | 125 | 33,157 | 9,137 | 117,718 | 2,516 | 61,722 |
| California | 8,139 | 971,315 | 1,819 | 219,928 | 490 | 15,751 | 61 | 10,724 | 68,056 | 724,912 | 5,044 | 88,103 |

[a] Census of manufactures, 1923.

[b] Includes motors driven by purchased current.

TABLE 38.—*Distribution by geographic divisions and States of total area of improved land on farms in the United States, 1869–1919* [a]

[Figures represent percentages]

| | 1869 | 1879 | 1889 | 1899 | 1909 | 1919 |
|---|---|---|---|---|---|---|
| United States | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| New England | 6.4 | 4.6 | 3.0 | 2.0 | 1.5 | 1.2 |
| Middle Atlantic | 15.4 | 11.6 | 8.9 | 7.5 | 6.1 | 5.3 |
| East North Central | 29.1 | 26.6 | 22.0 | 20.9 | 18.6 | 17.5 |
| West North Central | 12.4 | 21.5 | 29.5 | 32.7 | 34.4 | 34.1 |
| South Atlantic | 16.0 | 12.7 | 11.7 | 11.1 | 10.1 | 9.6 |
| East South Central | 12.8 | 10.8 | 10.0 | 9.7 | 9.2 | 8.8 |
| West South Central | 3.6 | 6.7 | 8.5 | 9.6 | 12.2 | 12.7 |
| Mountain | .3 | .8 | 1.5 | 2.0 | 3.3 | 6.0 |
| Pacific | 4.0 | 4.7 | 4.9 | 4.5 | 4.6 | 4.8 |
| New England: | | | | | | |
| Maine | 1.6 | 1.2 | .8 | .6 | .5 | .4 |
| New Hampshire | 1.3 | .8 | .5 | .3 | .2 | .2 |
| Vermont | 1.6 | 1.2 | .7 | .5 | .4 | .3 |
| Massachusetts | .9 | .7 | .5 | .3 | .2 | .2 |
| Rhode Island | .2 | .1 | .1 | [b] | [b] | [b] |
| Connecticut | .8 | .6 | .4 | .3 | .2 | .1 |
| Middle Atlantic: | | | | | | |
| New York | 8.3 | 6.2 | 4.6 | 3.8 | 3.1 | 2.6 |
| New Jersey | 1.1 | .7 | .6 | .5 | .4 | .3 |
| Pennsylvania | 6.0 | 4.7 | 3.7 | 3.2 | 2.6 | 2.4 |
| East North Central: | | | | | | |
| Ohio | 7.7 | 6.4 | 5.1 | 4.6 | 4.0 | 3.6 |
| Indiana | 5.4 | 4.9 | 4.2 | 4.0 | 3.5 | 3.3 |
| Illinois | 10.2 | 9.2 | 7.2 | 6.7 | 5.8 | 5.4 |
| Michigan | 2.7 | 2.9 | 2.8 | 2.8 | 2.8 | 2.7 |
| Wisconsin | 3.1 | 3.2 | 2.7 | 2.8 | 2.5 | 2.5 |
| West North Central: | | | | | | |
| Minnesota | 1.2 | 2.6 | 3.1 | 4.4 | 4.1 | 4.3 |
| Iowa | 5.0 | 7.0 | 7.0 | 7.2 | 6.1 | 5.2 |
| Missouri | 4.8 | 5.9 | 5.5 | 5.6 | 5.2 | 5.1 |
| North Dakota | [b] | [b] | 1.3 | 2.3 | 4.3 | 4.9 |
| South Dakota | [b] | .3 | 2.0 | 2.7 | 3.3 | 3.6 |
| Nebraska | .3 | 1.9 | 4.3 | 4.5 | 5.1 | 4.9 |
| Kansas | 1.1 | 3.8 | 6.3 | 6.0 | 6.3 | 6.1 |
| South Atlantic: | | | | | | |
| Delaware | .4 | .3 | .1 | [b] | [b] | .1 |
| Maryland | 1.5 | 1.2 | 1.0 | .8 | .7 | .6 |
| District of Columbia | [b] | [b] | [b] | [b] | .1 | [b] |
| Virginia | 4.3 | 3.0 | 2.6 | 2.5 | 2.1 | 1.9 |
| West Virginia | 1.4 | 1.3 | 1.3 | 1.4 | 1.1 | 1.1 |
| North Carolina | 2.8 | 2.3 | 2.2 | 2.0 | 1.8 | 1.6 |
| South Carolina | 1.6 | 1.4 | 1.5 | 1.4 | 1.3 | 1.2 |
| Georgia | 3.6 | 2.9 | 2.7 | 2.6 | 2.6 | 2.6 |
| Florida | .4 | .3 | .3 | .4 | .4 | .5 |
| East South Central: | | | | | | |
| Kentucky | 4.3 | 3.8 | 3.3 | 3.3 | 3.0 | 2.8 |
| Tennessee | 3.6 | 3.0 | 2.6 | 2.5 | 2.3 | 2.2 |
| Alabama | 2.7 | 2.2 | 2.2 | 2.1 | 2.0 | 2.0 |
| Mississippi | 2.2 | 1.8 | 1.9 | 1.8 | 1.9 | 1.8 |
| West South Central: | | | | | | |
| Arkansas | 1.0 | 1.3 | 1.5 | 1.7 | 1.7 | 1.8 |
| Louisiana | 1.1 | .9 | 1.0 | 1.1 | 1.1 | 1.1 |
| Oklahoma | | | .2 | 2.1 | 3.7 | 3.6 |
| Texas | 1.5 | 4.5 | 5.8 | 4.7 | 5.7 | 6.2 |
| Mountain: | | | | | | |
| Montana | .1 | .1 | .3 | .4 | .8 | 2.2 |
| Idaho | [b] | .1 | .2 | .3 | .5 | .9 |
| Wyoming | [b] | [b] | .1 | .2 | .3 | .4 |
| Colorado | .1 | .2 | .5 | .6 | .8 | 1.6 |
| New Mexico | .1 | .1 | .1 | .1 | .3 | .3 |
| Arizona | [b] | [b] | [b] | .1 | .1 | .1 |
| Utah | [b] | .2 | .2 | .2 | .3 | .4 |
| Nevada | [b] | .1 | .1 | .1 | .2 | .1 |
| Pacific: | | | | | | |
| Washington | .1 | .2 | .5 | .8 | 1.3 | 1.4 |
| Oregon | .6 | .8 | 1.0 | .8 | .9 | 1.0 |
| California | 3.3 | 3.7 | 3.4 | 2.9 | 2.4 | 2.4 |

[a] Based on census reports.

[b] Less than 0.1 per cent.

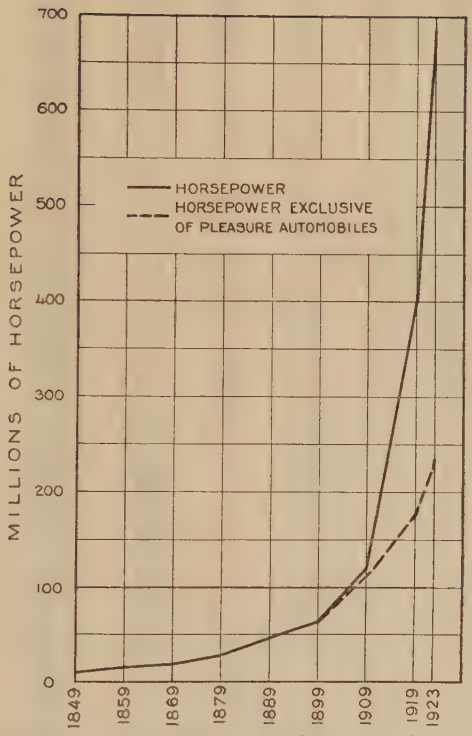



FIGURE 1.—Total horsepower of prime movers in the United States, 1849–1923. (Table 1)

61750—28——6

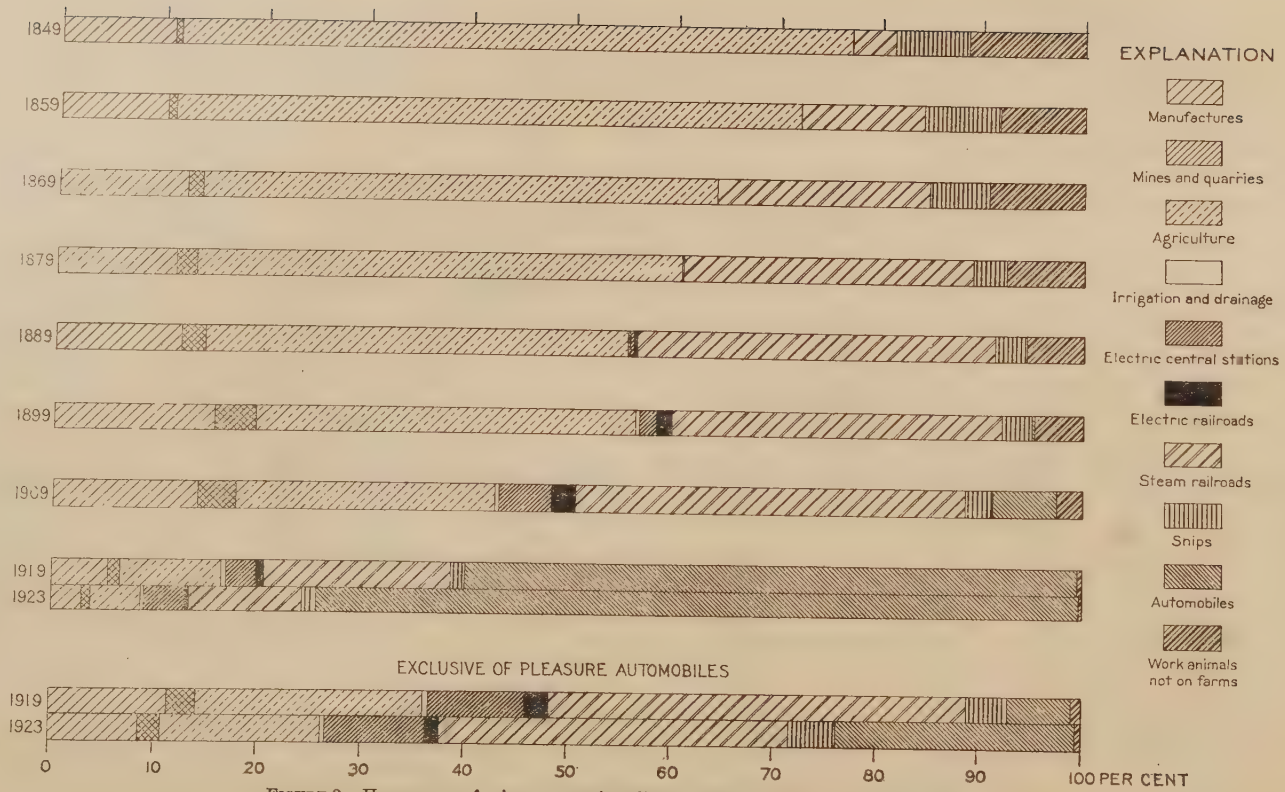



FIGURE 2.—Horsepower of prime movers installed in different activities, 1849–1923. (Table 2)

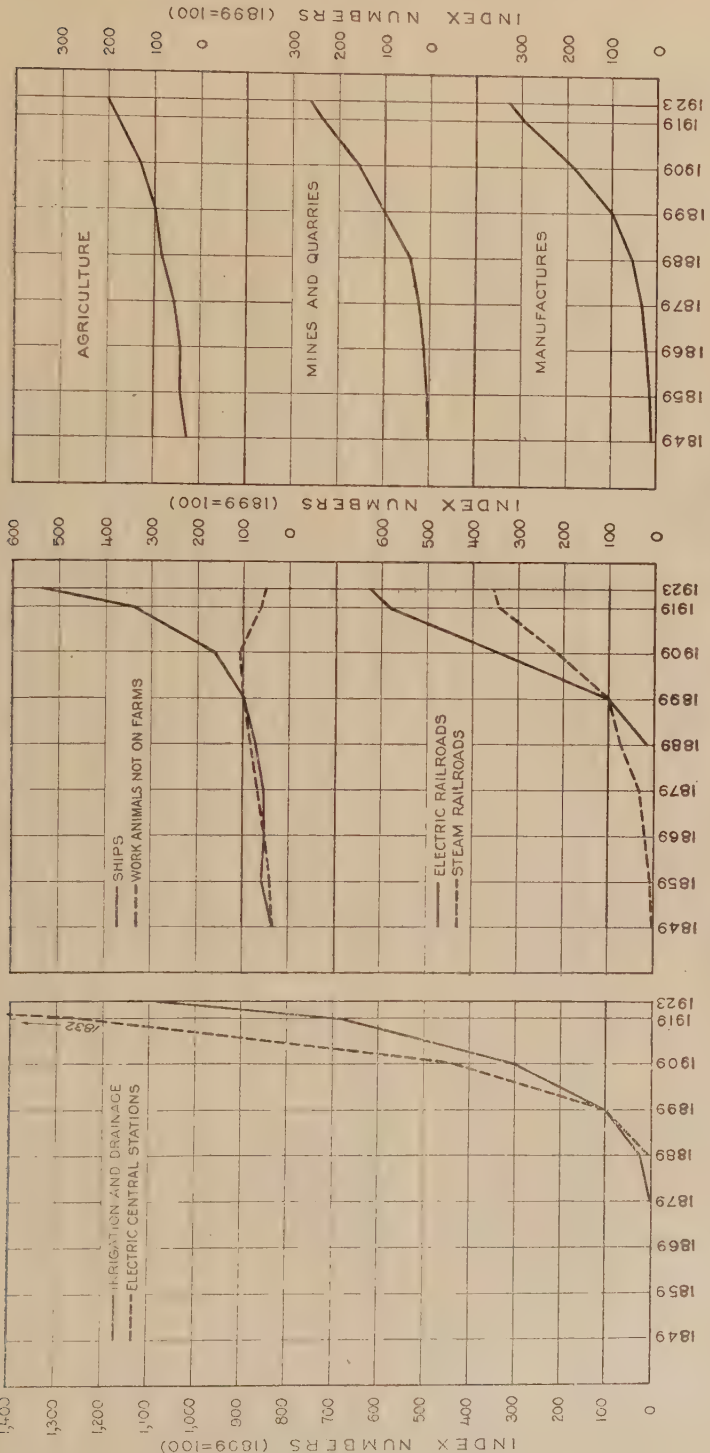



FIGURE 3.—Horsepower utilized in each field of activity, 1849–1923. (Table 3)

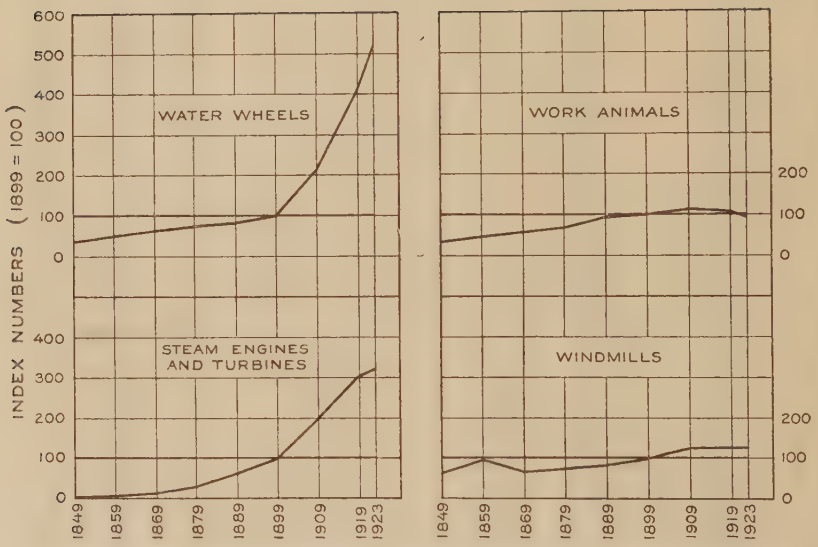



FIGURE 4.—Index numbers of horsepower of prime movers, 1849–1923, by types of prime movers. (Table 4–C)

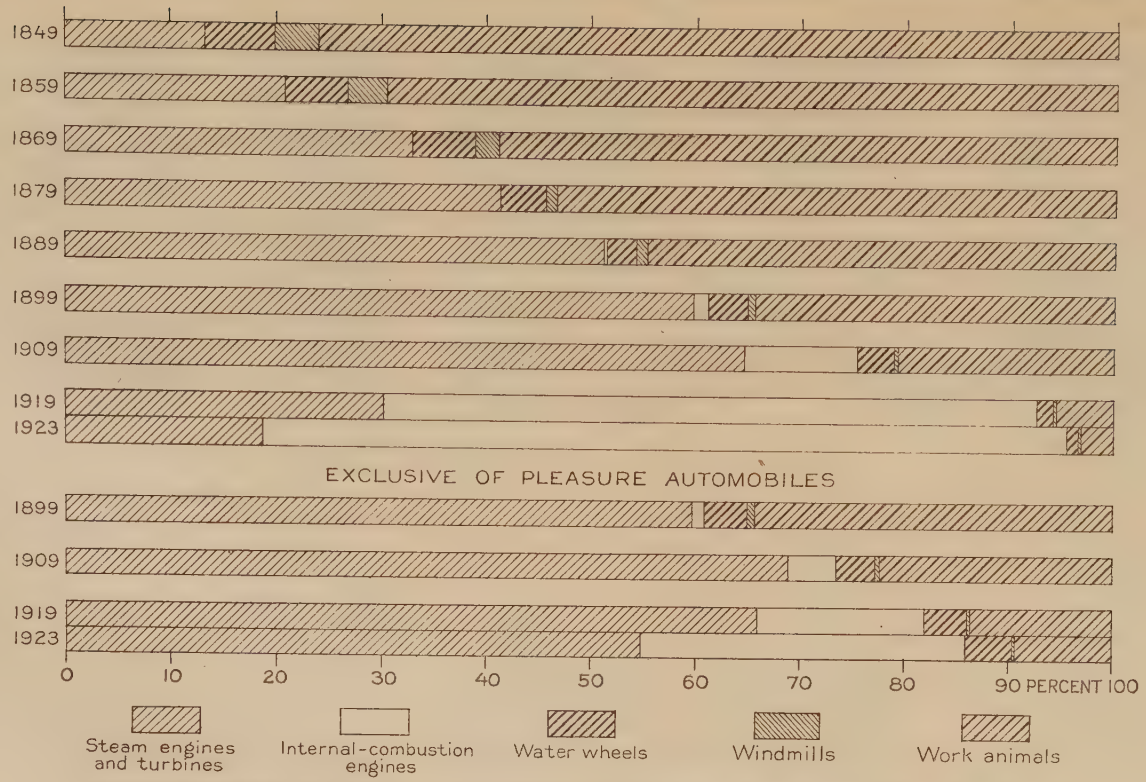



FIGURE 5.—Percentages of horsepower of prime movers, 1849–1923, by different types of prime movers. (Table 4–B)

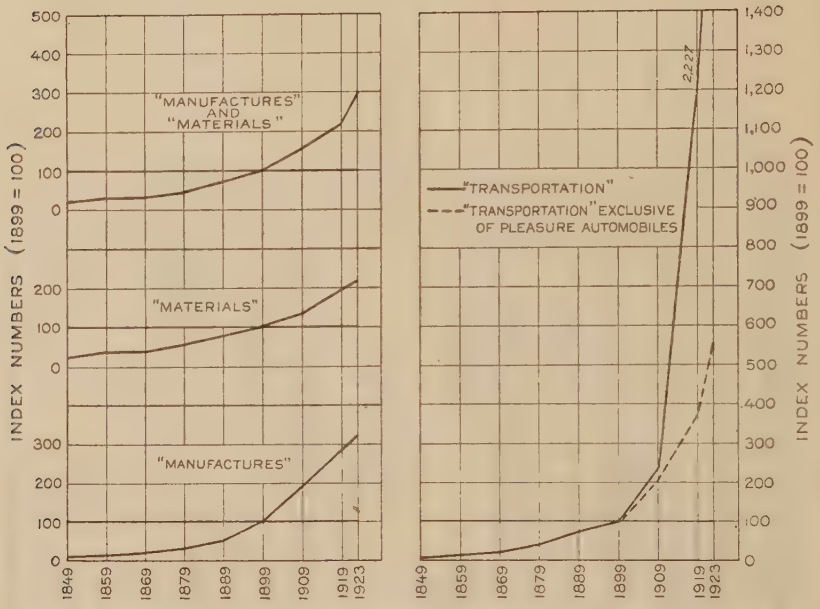



FIGURE 6.—Horsepower of prime movers, 1849–1923, by special groups. (Table 6.) (See also fig. 7)

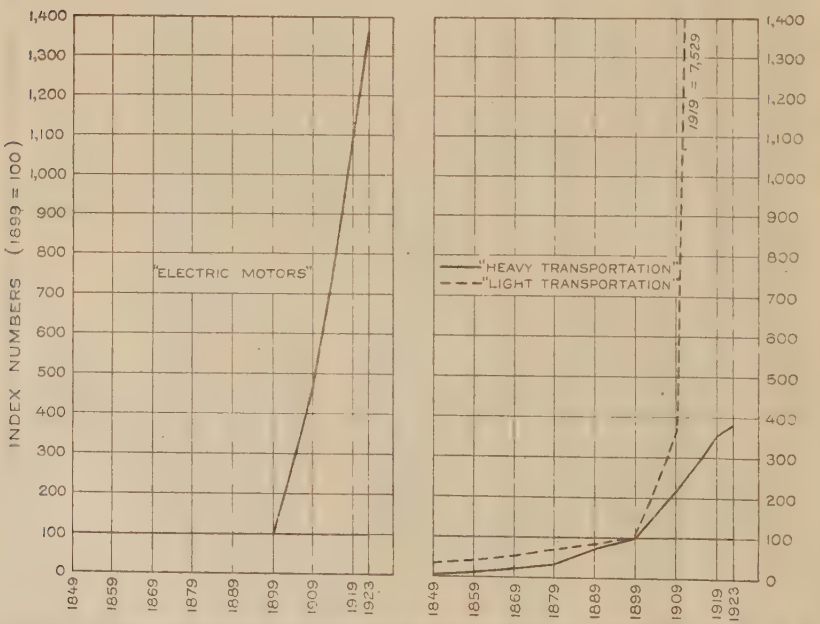
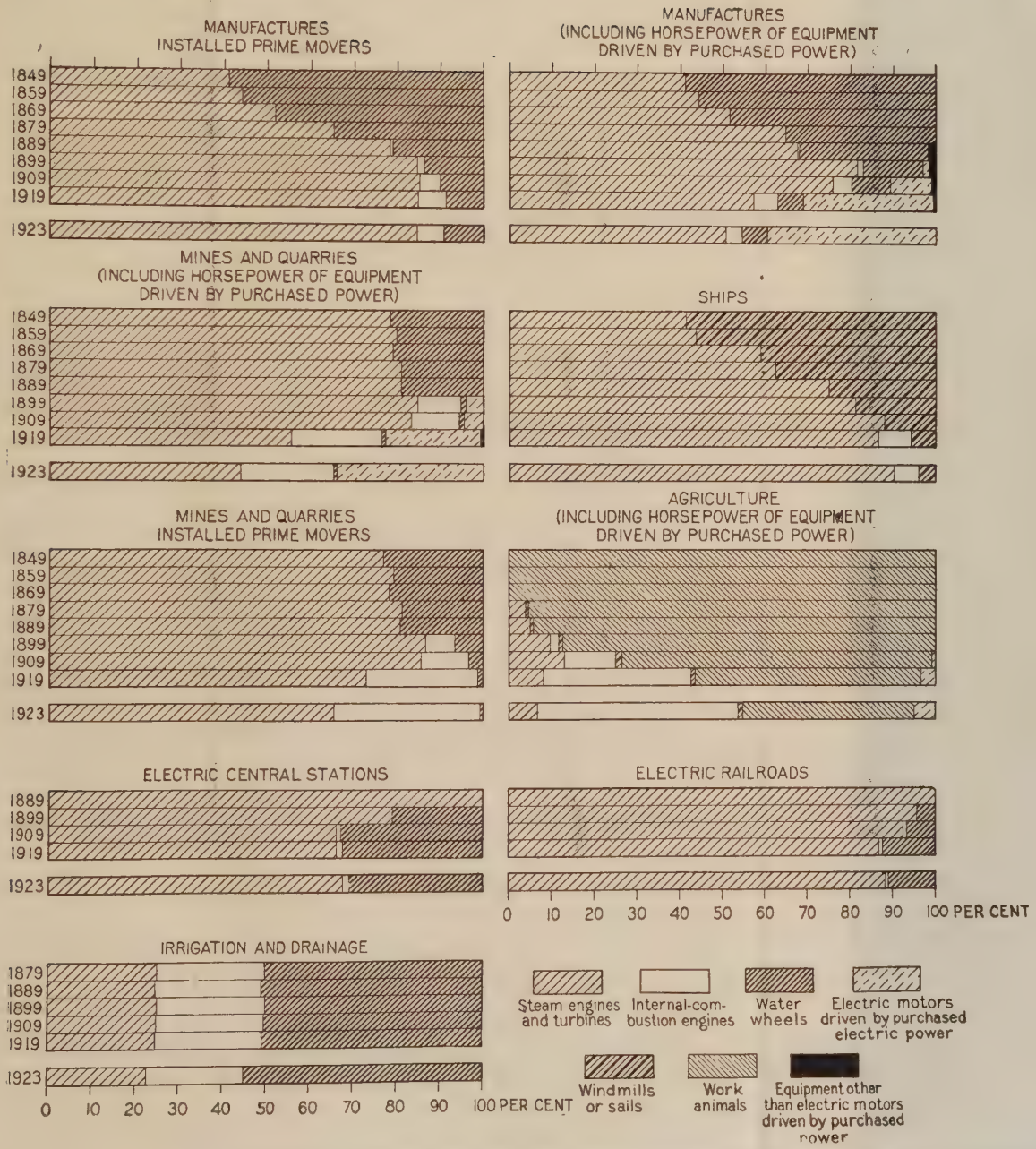



FIGURE 7.—Horsepower of prime movers, 1849–1923, by special groups. (Table 6.) (See also fig. 6)




**HORSEPOWER OF PRIME MOVERS INSTALLED AND UTILIZED IN DIFFERENT ACTIVITIES, 1849-1923, BY TYPES OF PRIME MOVERS**

Based on data in Table 5

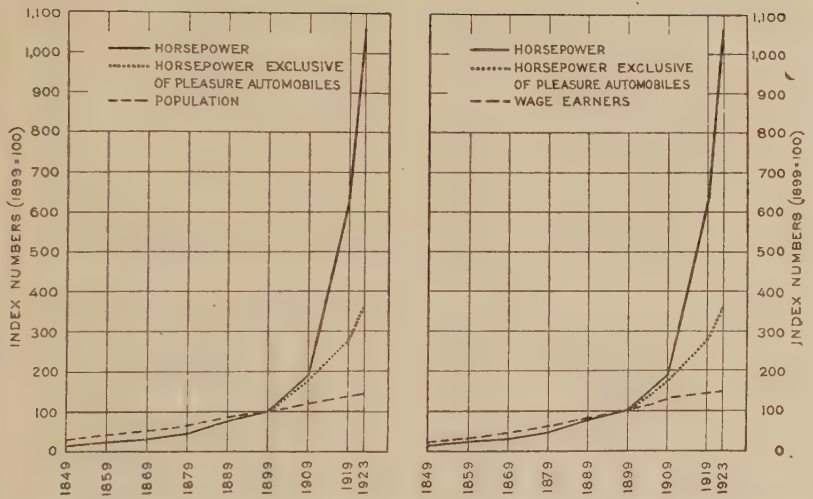



FIGURE 8.—Horsepower of prime movers, population, and wage earners in United States, 1849–1923. (Tables 1, 3, and 7.) (See also figs. 9, 10)

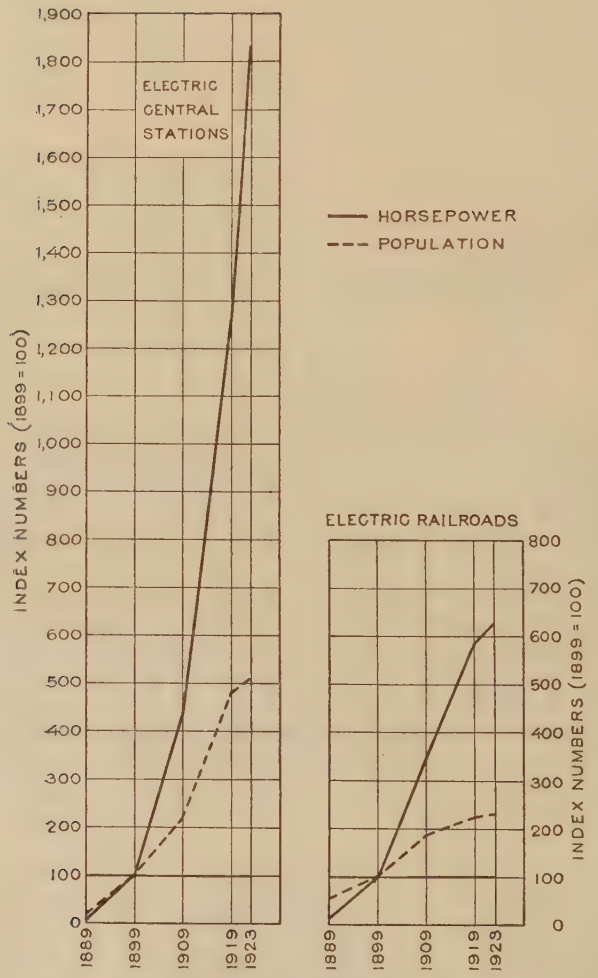



FIGURE 9.—Horsepower of prime movers, population, and wage earners in United States, 1849–1923. (Tables 1, 3, and 7.) (See also figs. 8, 10)

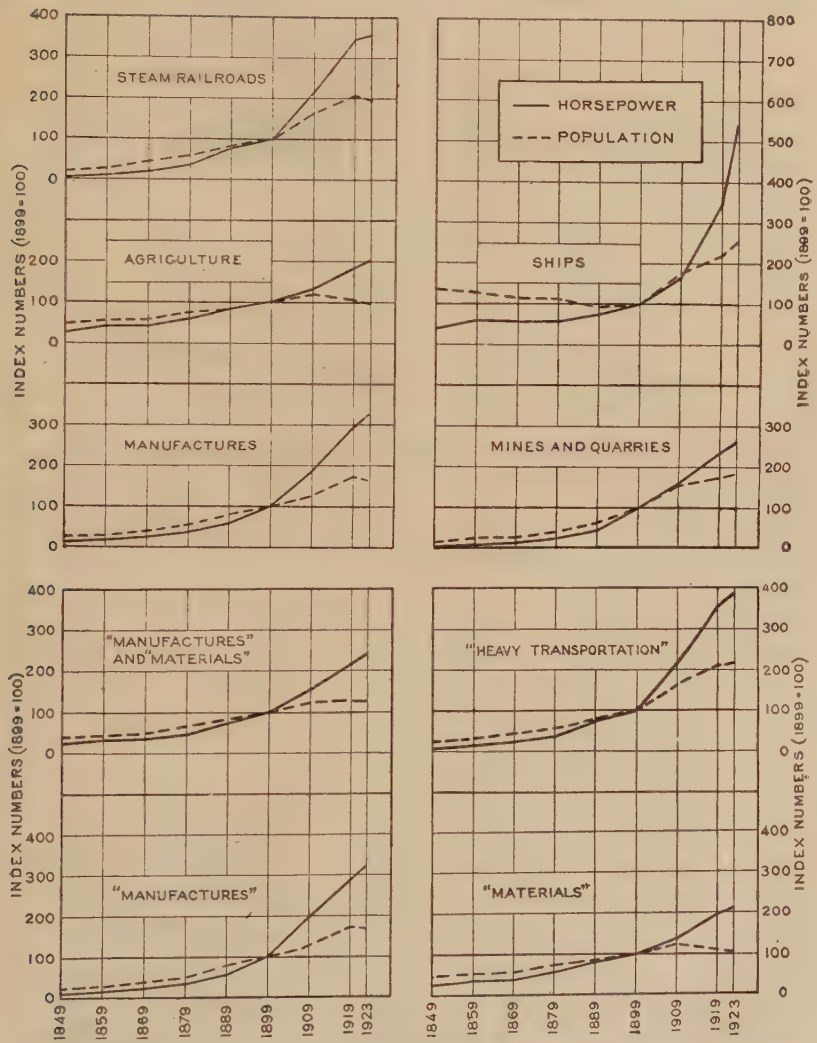



FIGURE 10.—Horsepower of prime movers, population, and wage earners in United States, 1849–1923. (Tables 1, 3, and 7.) (See also figs. 8, 9)

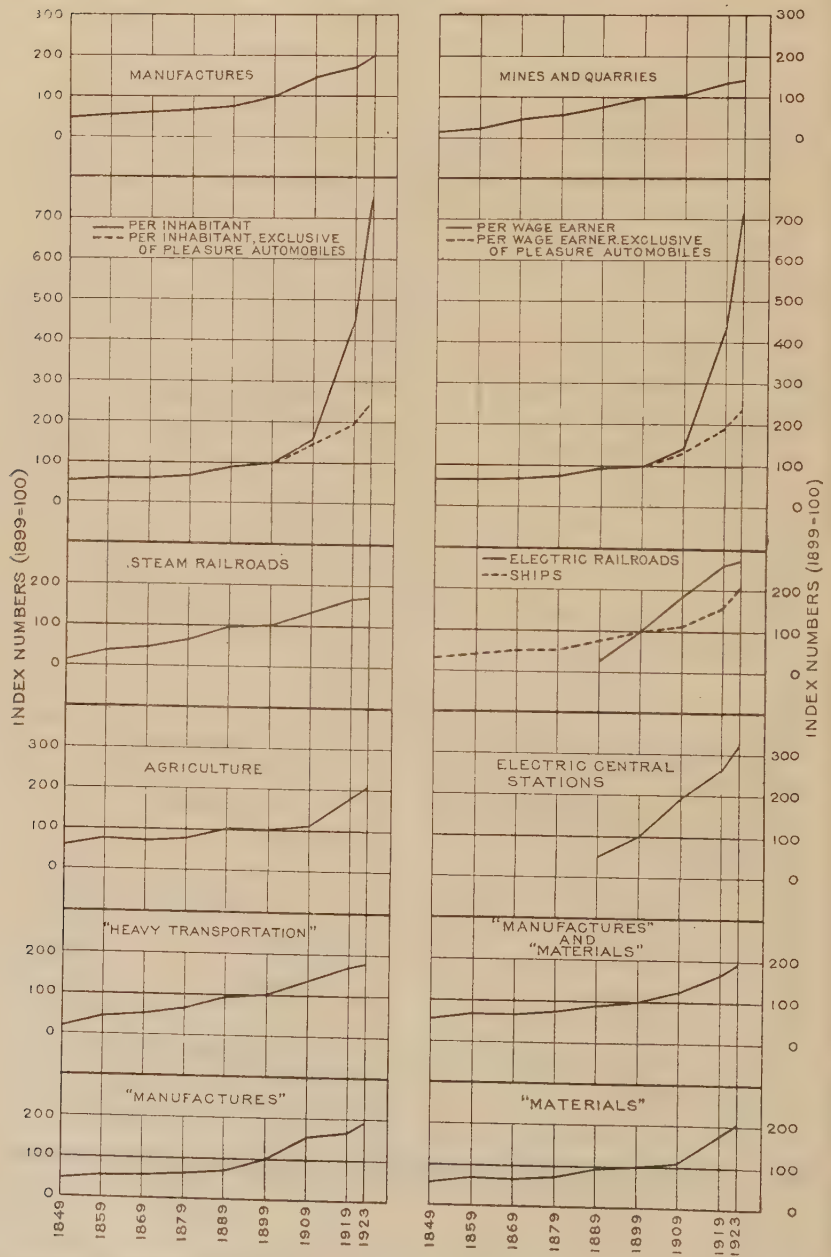



FIGURE 11.—Horsepower of prime movers installed per inhabitant and per wage earner and utilized per wage earner in different activities and groups, 1849–1923. (Table 8)

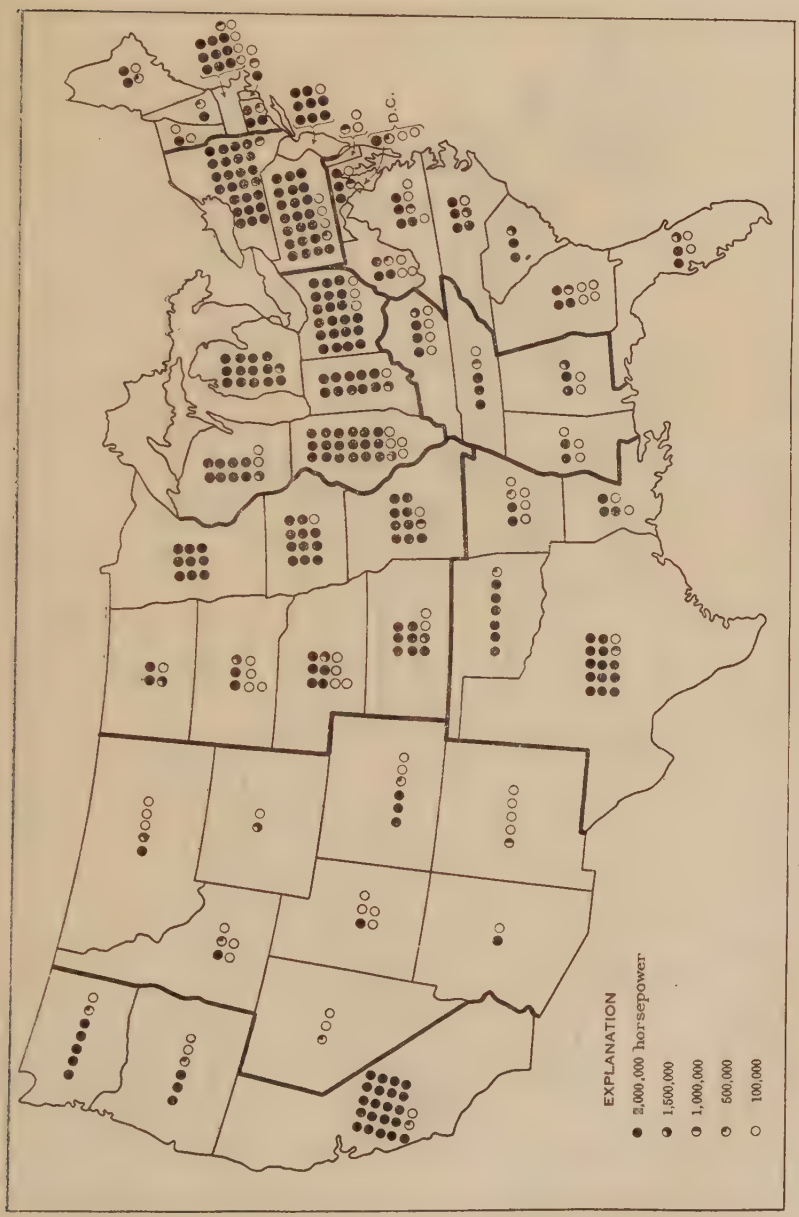



FIGURE 12.—Total horsepower of prime movers, 1923. (Table 9)

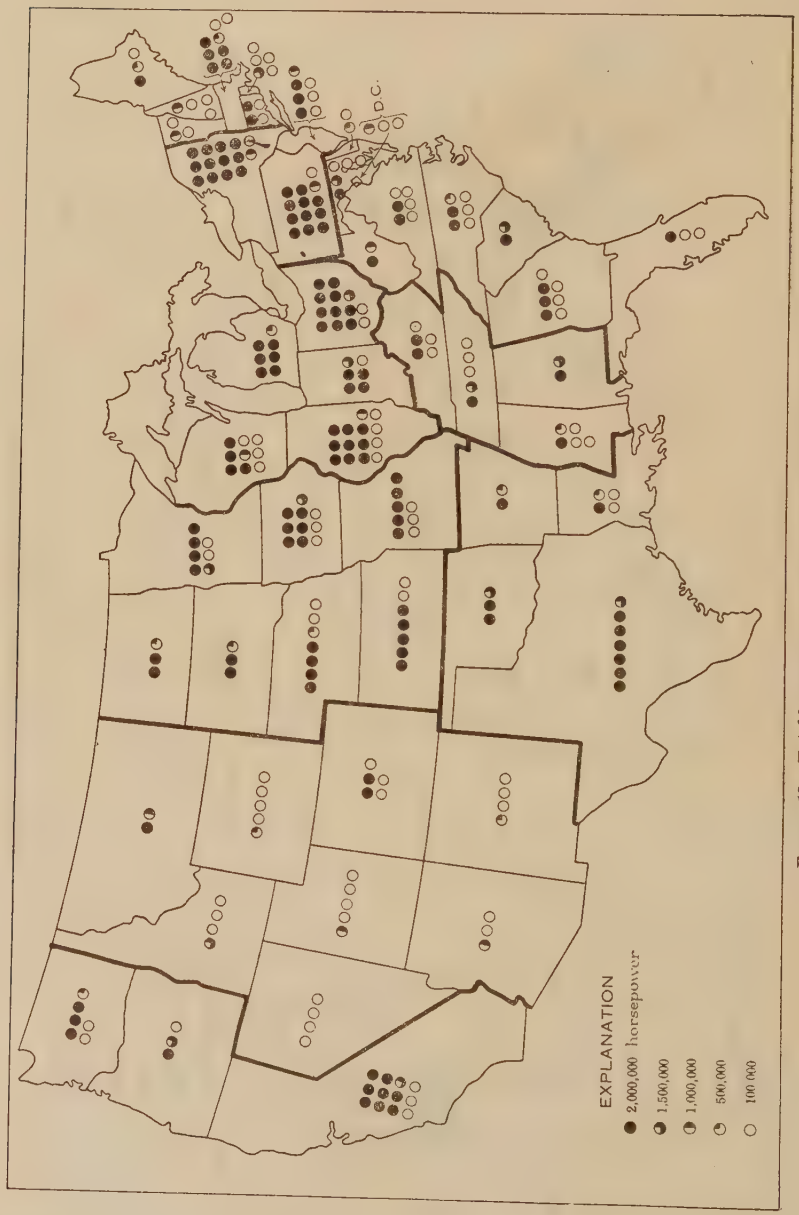



FIGURE 13.—Total horsepower of prime movers, 1919. (Table 9)

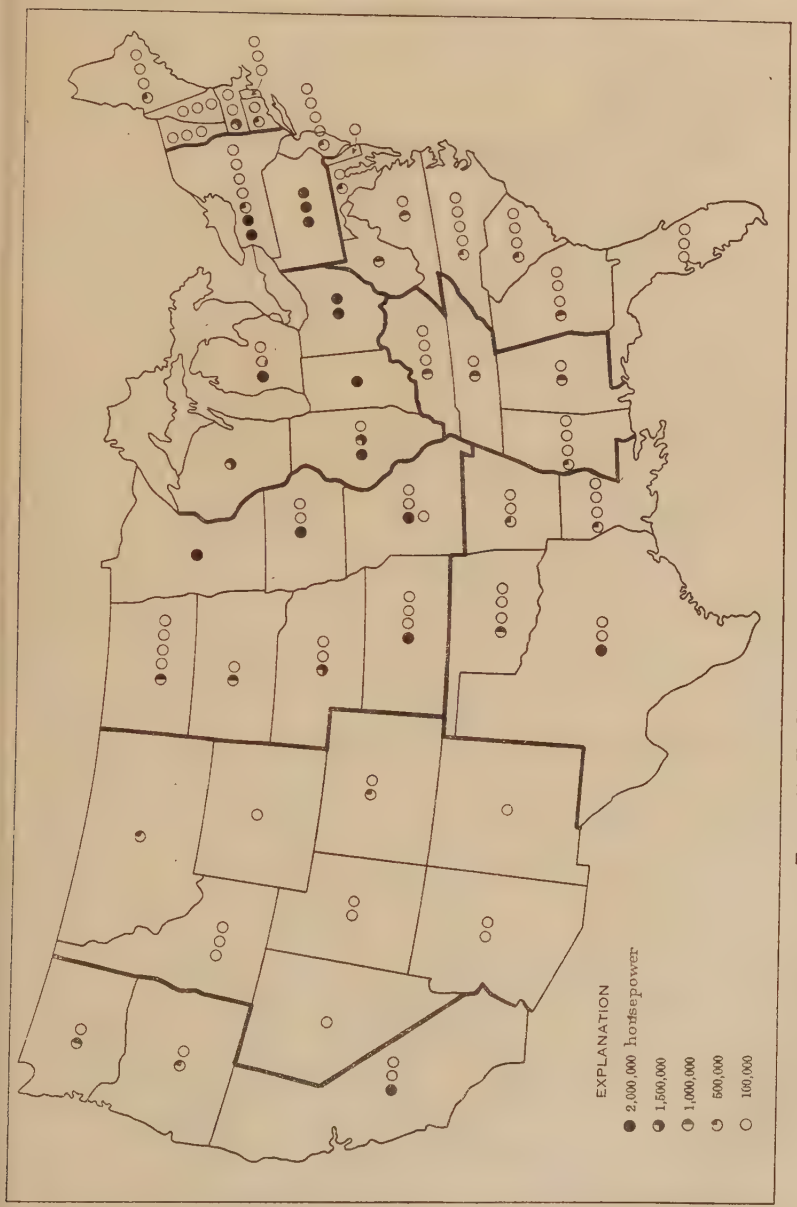



FIGURE 14.—Total horsepower of prime movers, 1909. (Table 9)

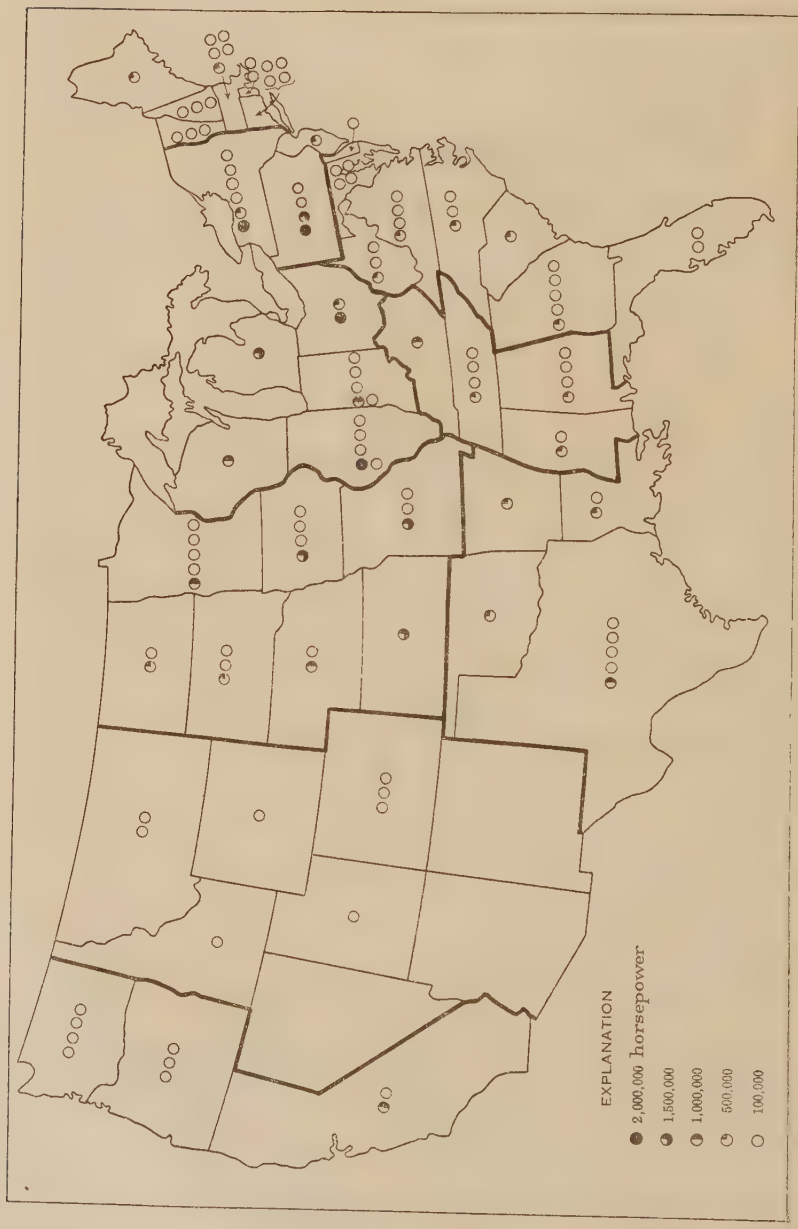



FIGURE 15.—Total horsepower of prime movers, 1899. (Table 9)

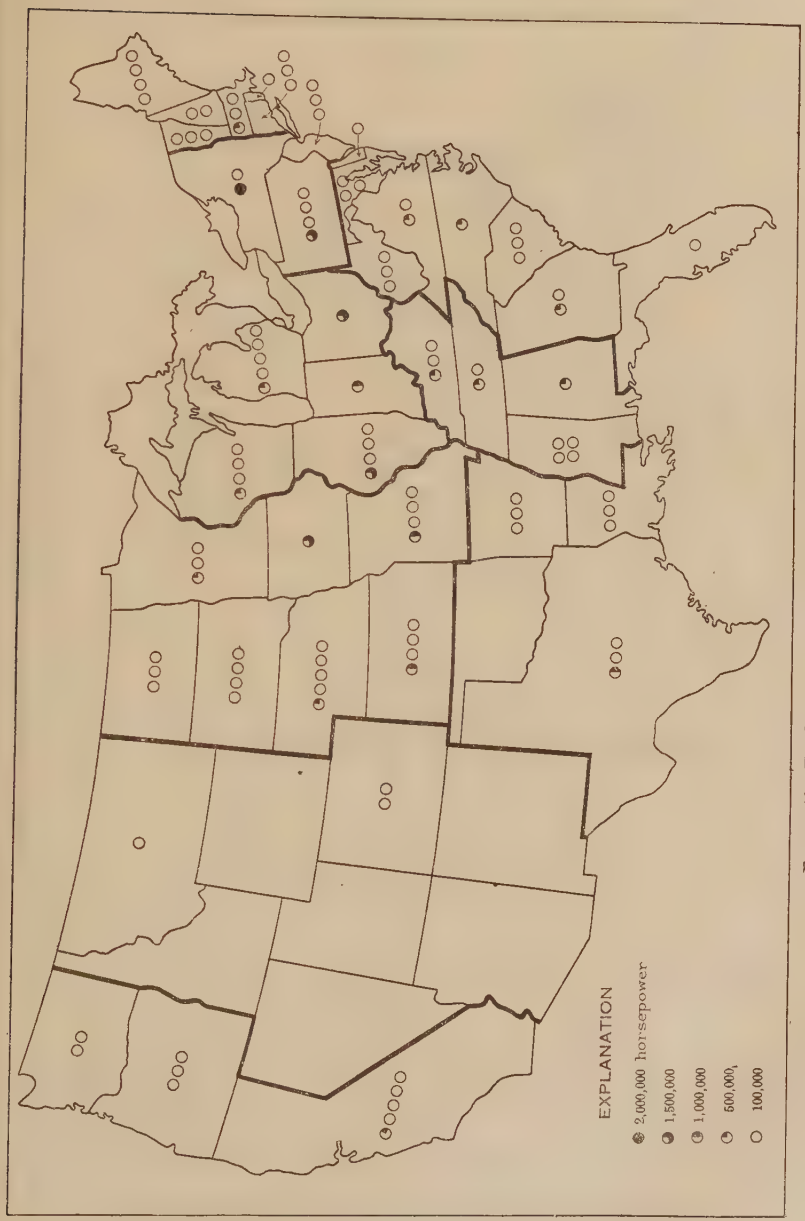



FIGURE 16.—Total horsepower of prime movers, 1889, (Table 9)

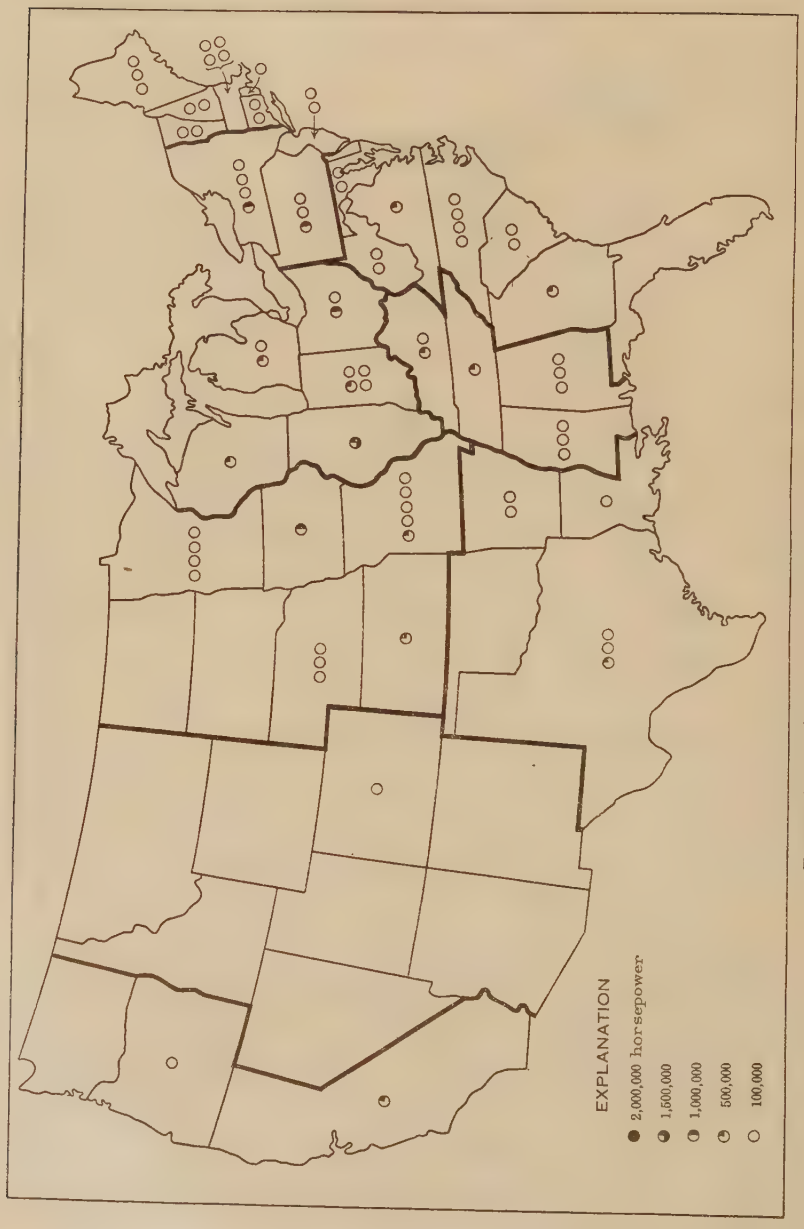



FIGURE 17.—Total horsepower of prime movers, 1879. (Table 9)

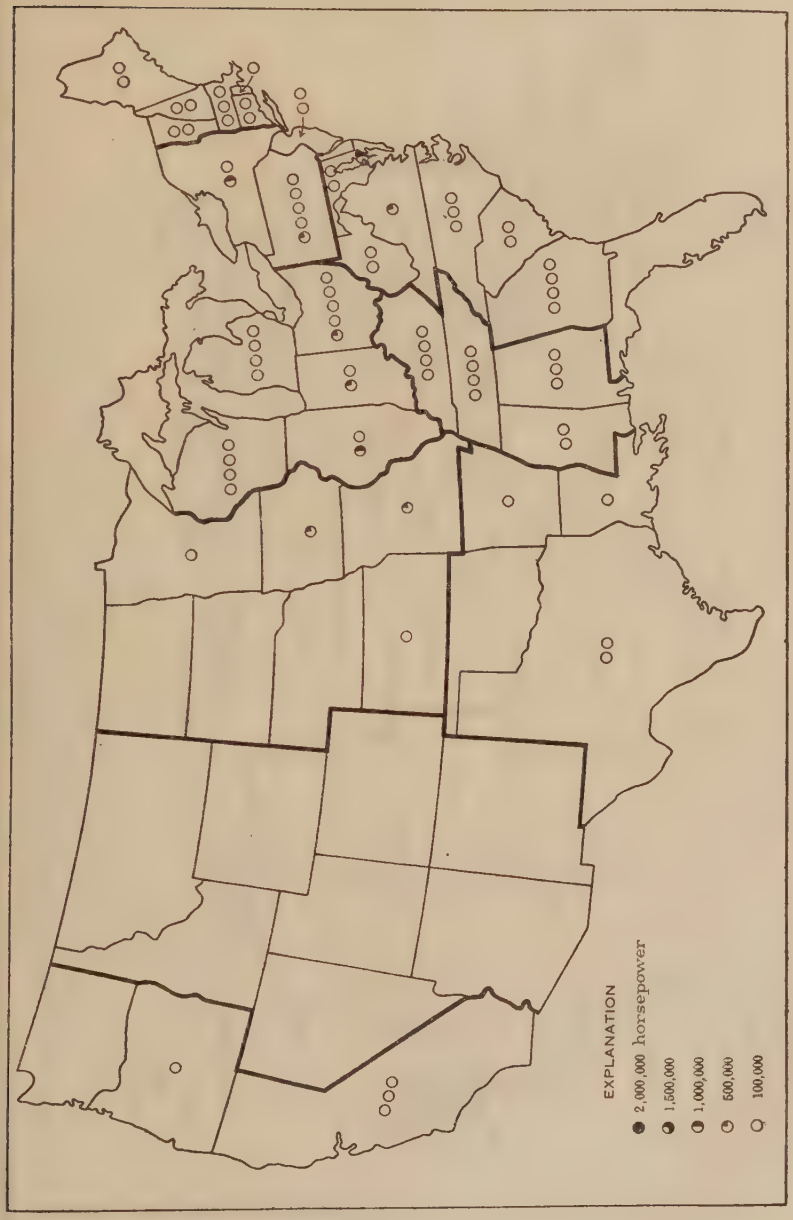



FIGURE 18.—Total horsepower of prime movers, 1869. (Table 9)

61750—28——7

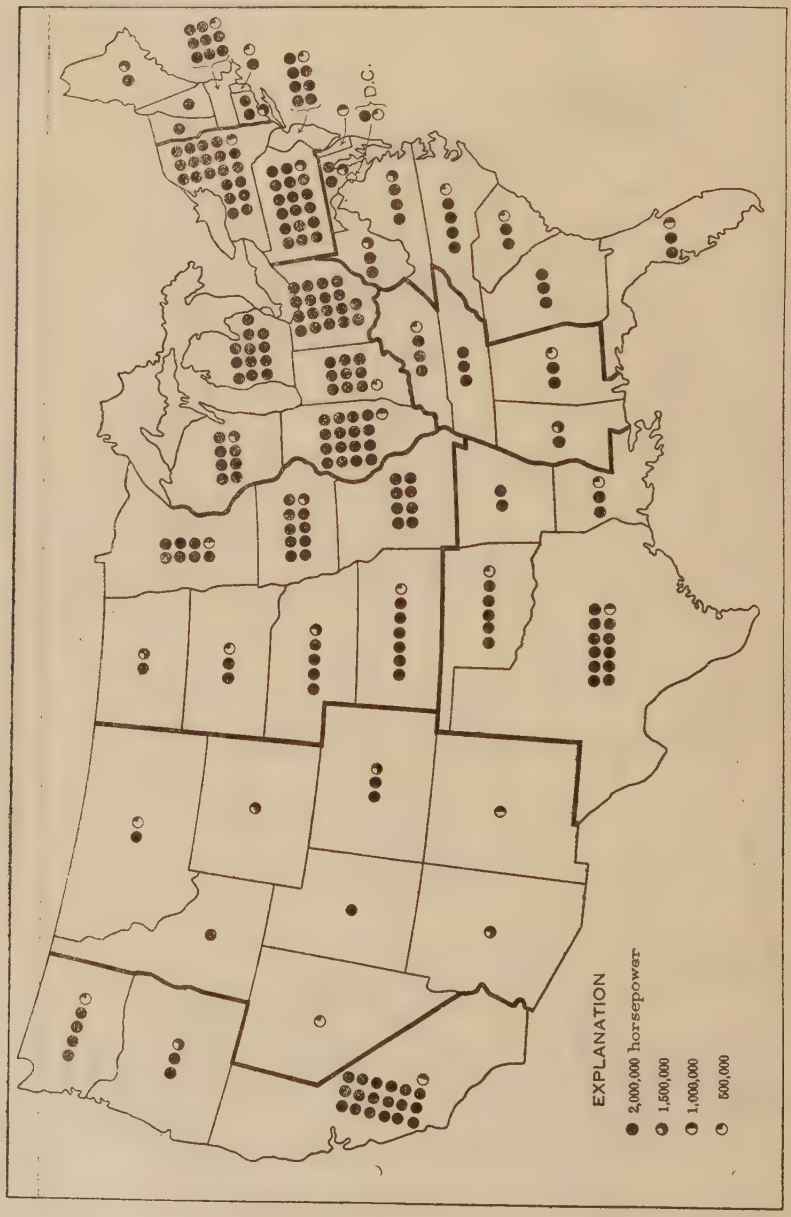



FIGURE 19.—Horsepower of prime movers in motor-driven vehicles, 1923. (Table 20)

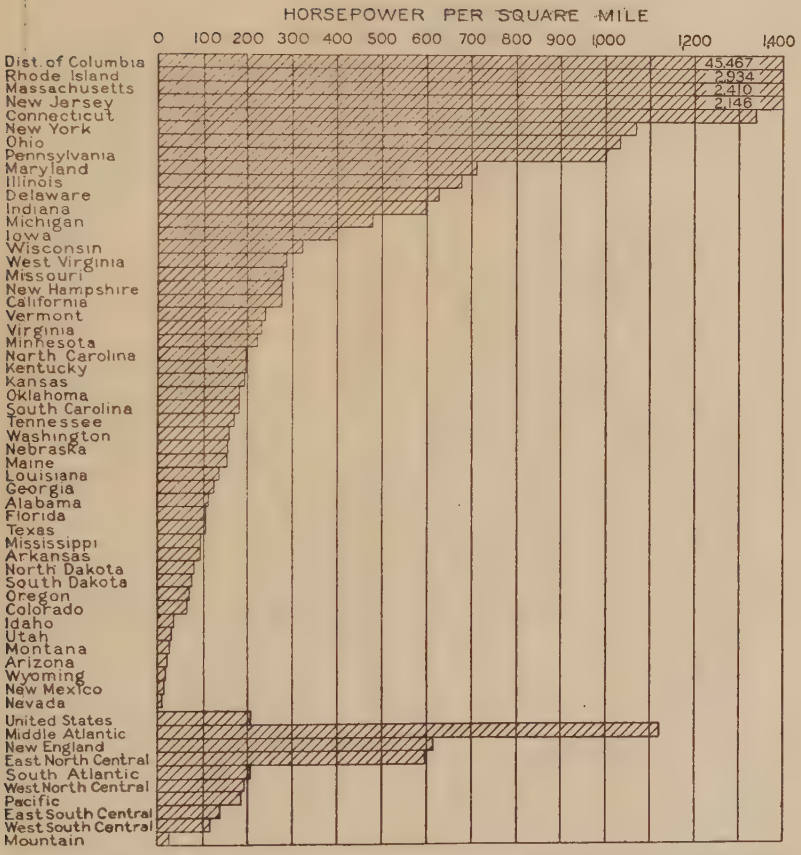



FIGURE 20.—Horsepower of prime movers per square mile, 1923, by States and geographic divisions. (Table 10.) Includes all prime movers except steam railroads and work animals not on farms

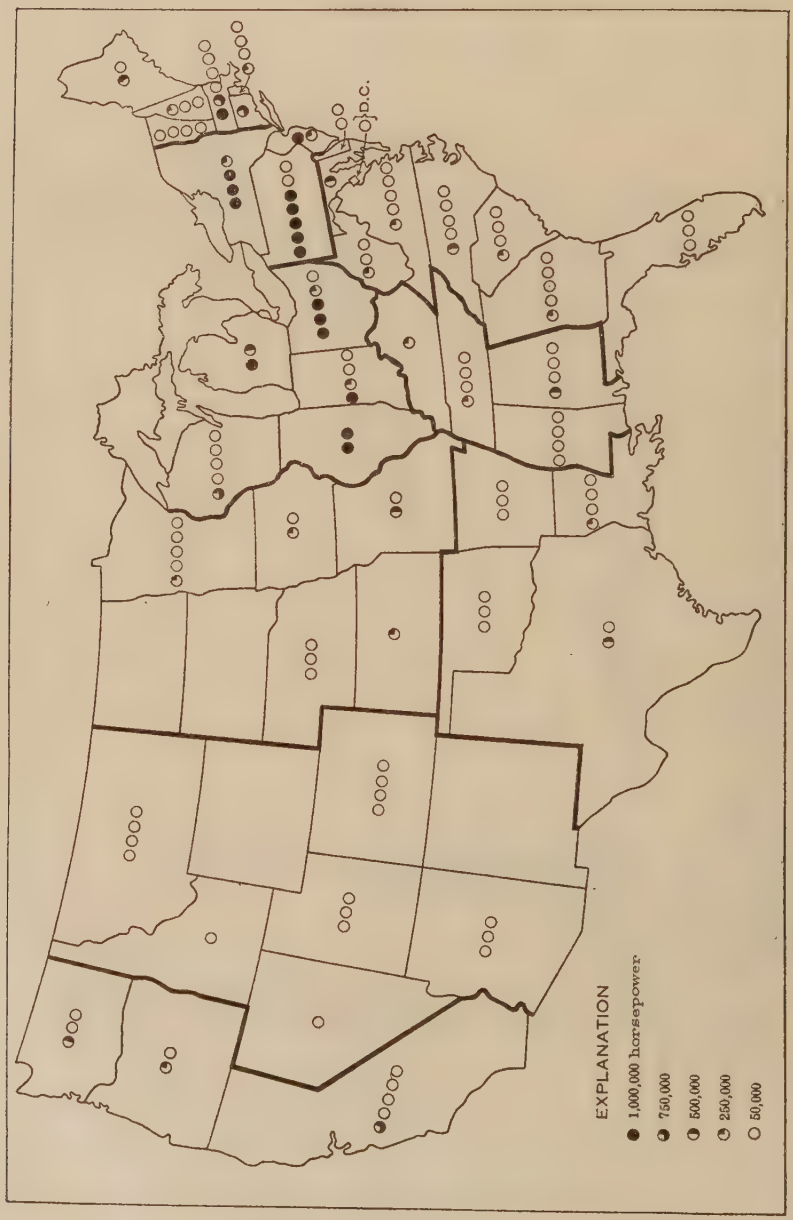



FIGURE 21.—Horsepower of prime movers utilized in manufactures, 1923. (Table 11)

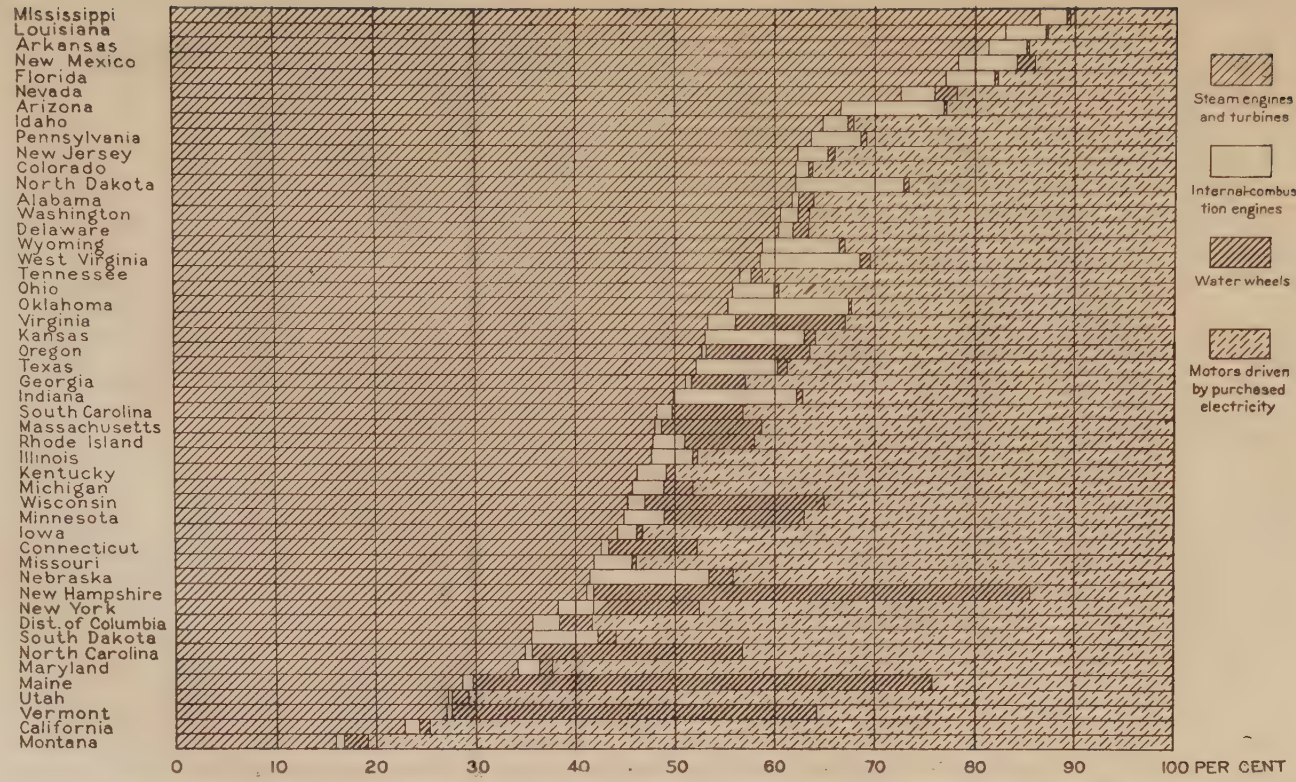



FIGURE 22.—Percentage of total horsepower of prime movers utilized in manufactures, 1923, by types of prime movers. (Table 12)

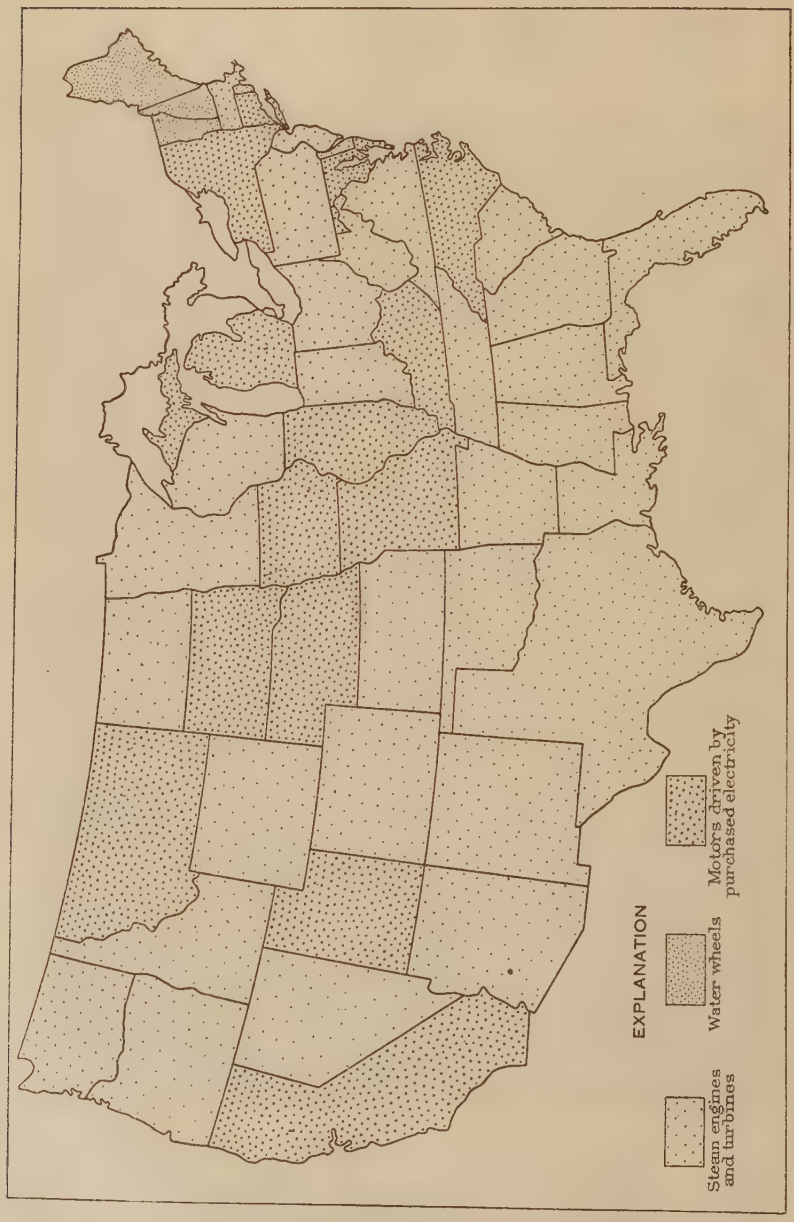



FIGURE 23.—Chief types of prime movers utilized in manufactures, 1923. (Table 12)

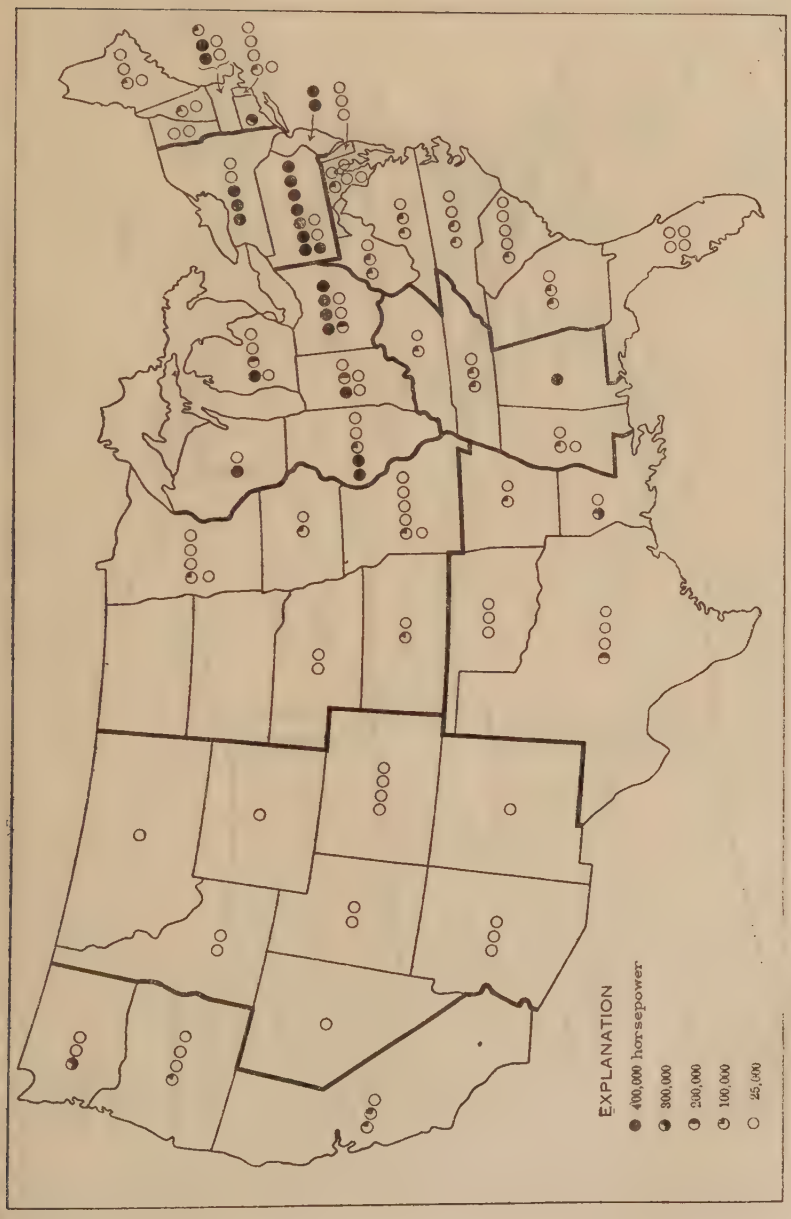



FIGURE 24.—Horsepower of steam engines and turbines utilized in manufactures, 1923. (Table 37)

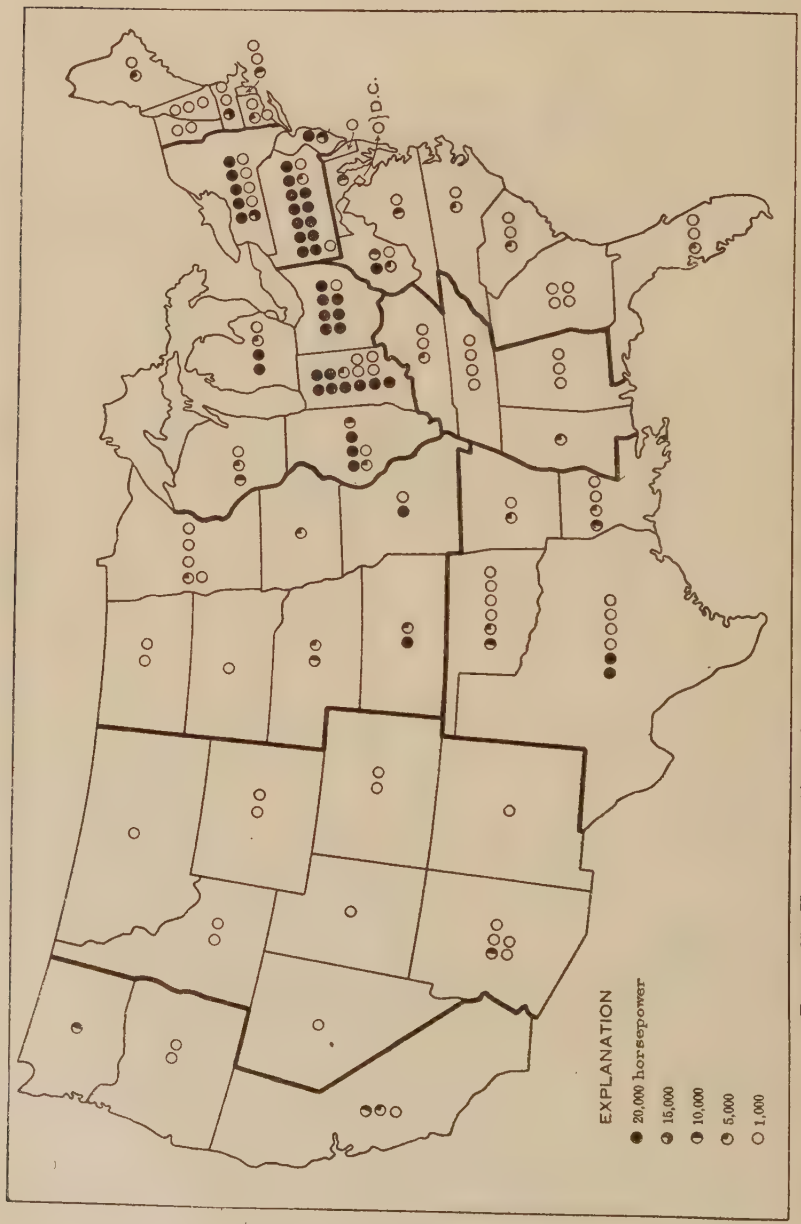



FIGURE 25.—Horsepower of internal-combustion engines installed in manufactures, 1923. (Table 37)

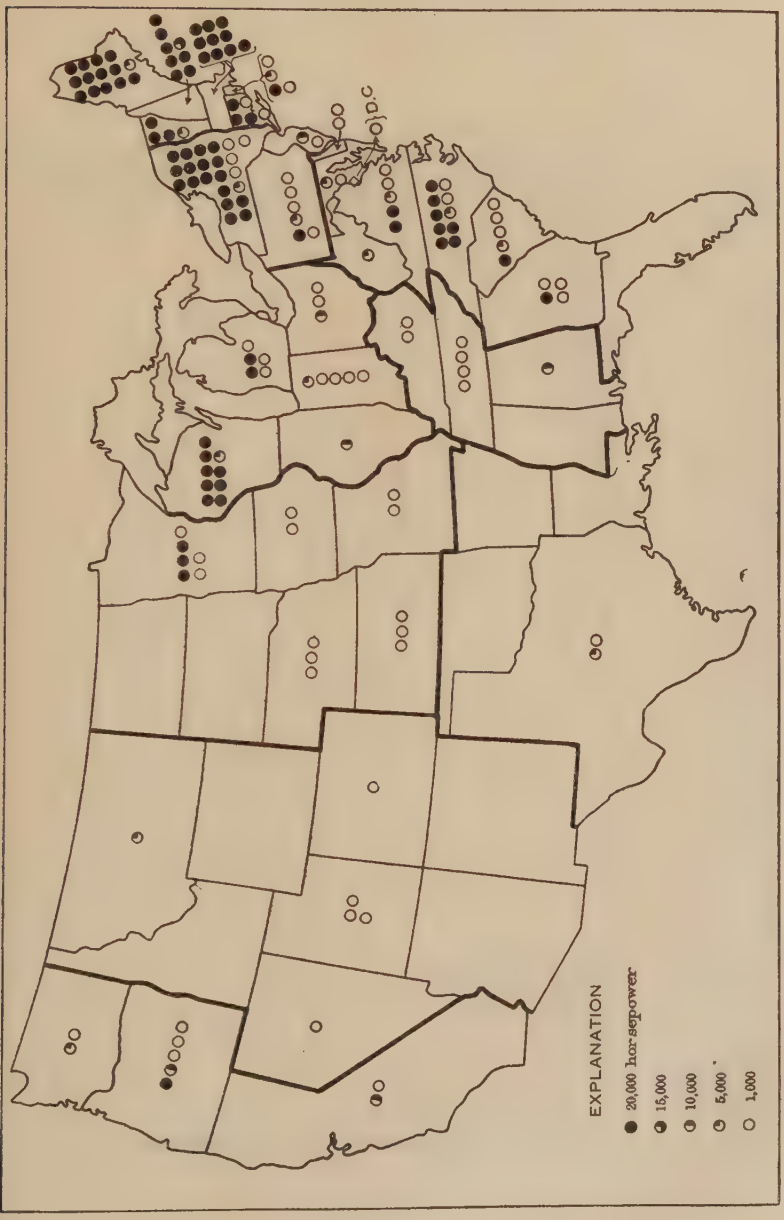



FIGURE 26.—Horsepower of water wheels installed in manufactures, 1923. (Table 37)

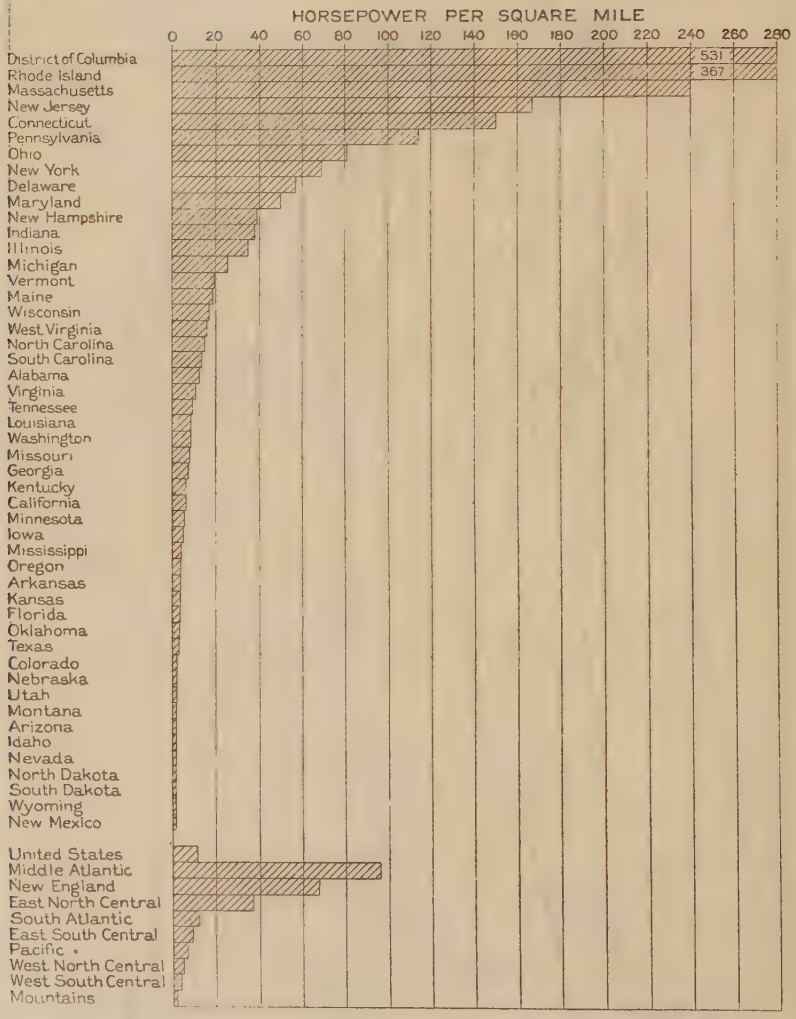



FIGURE 27.—Horsepower per square mile of prime movers utilized in manufactures, 1923. (Table 10)

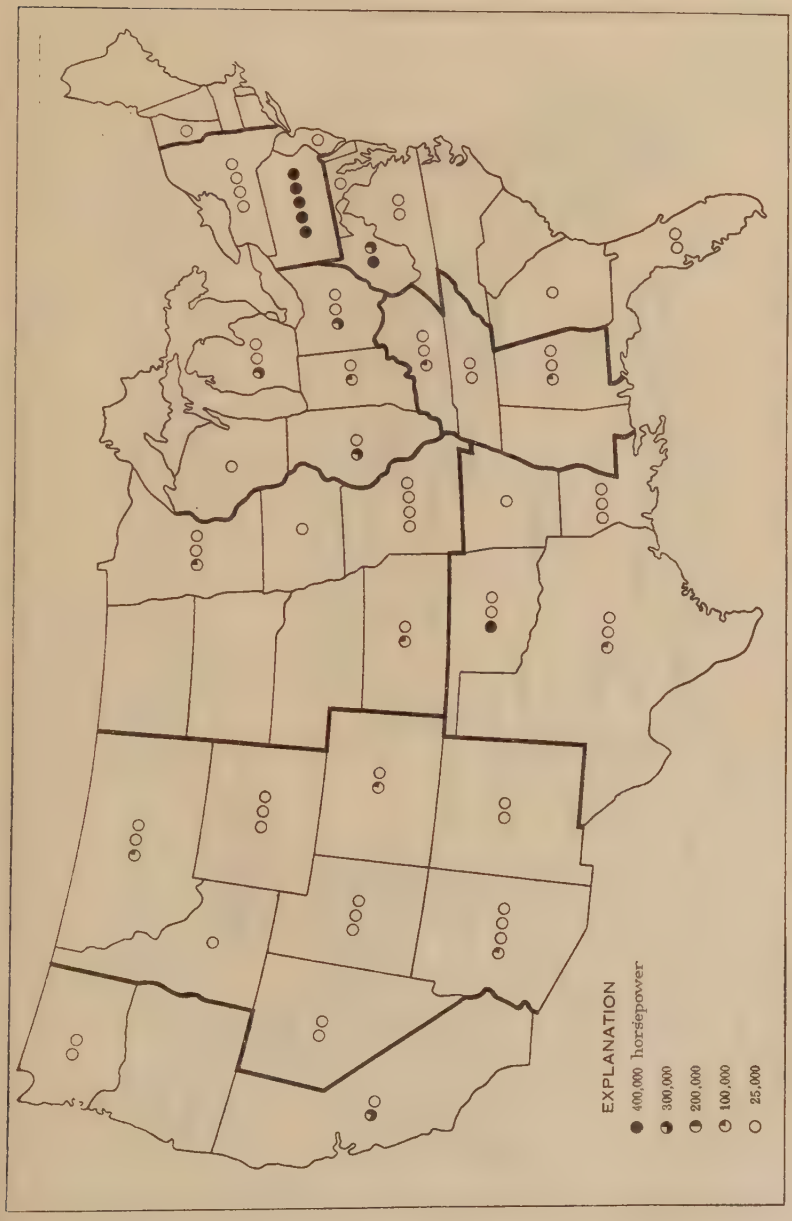



FIGURE 28.—Horsepower of prime movers utilized in mines and quarries, 1919. (Table 13)

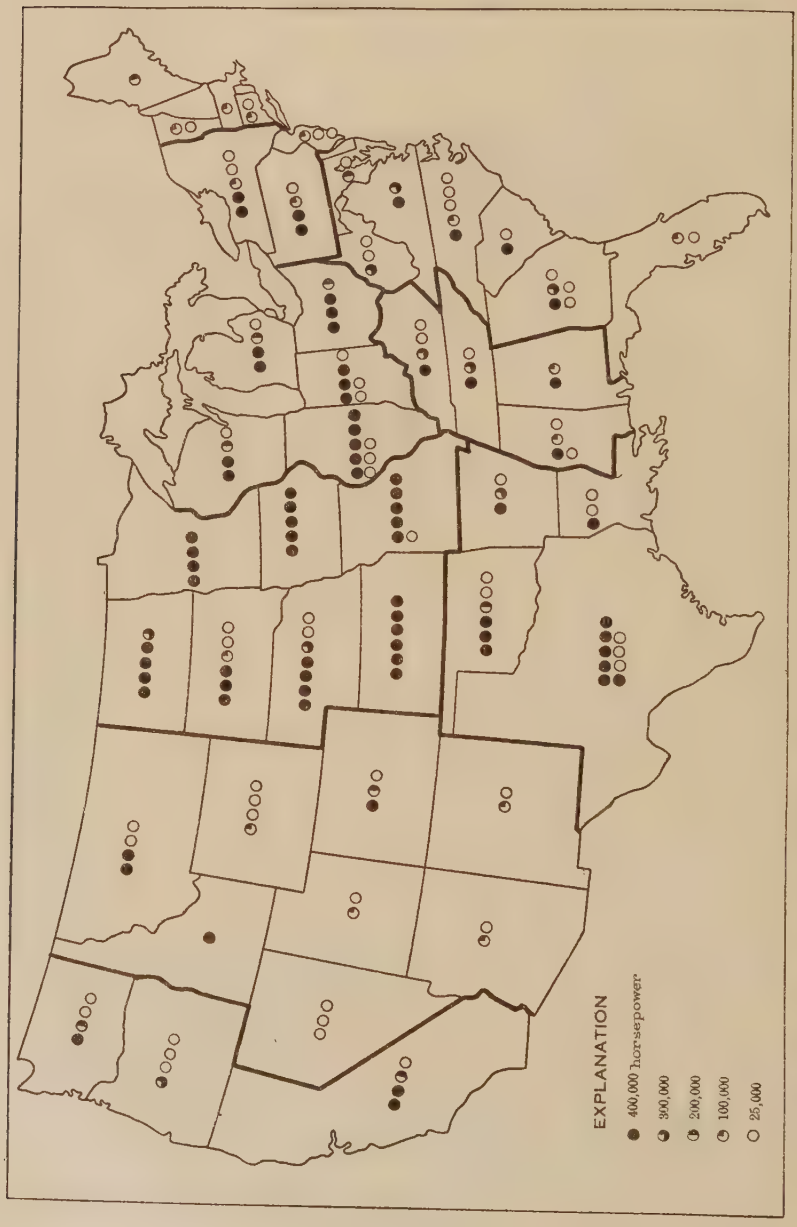



FIGURE 29.—Horsepower of prime movers utilized in agriculture, 1923. (Table 14)

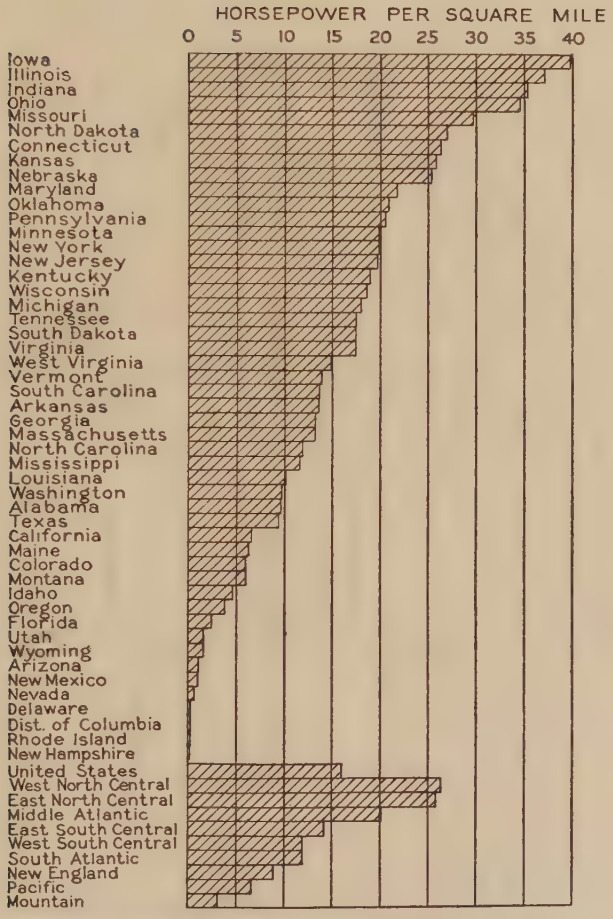



FIGURE 30.—Horsepower per square mile of prime movers utilized in agriculture, 1923. (Table 10)

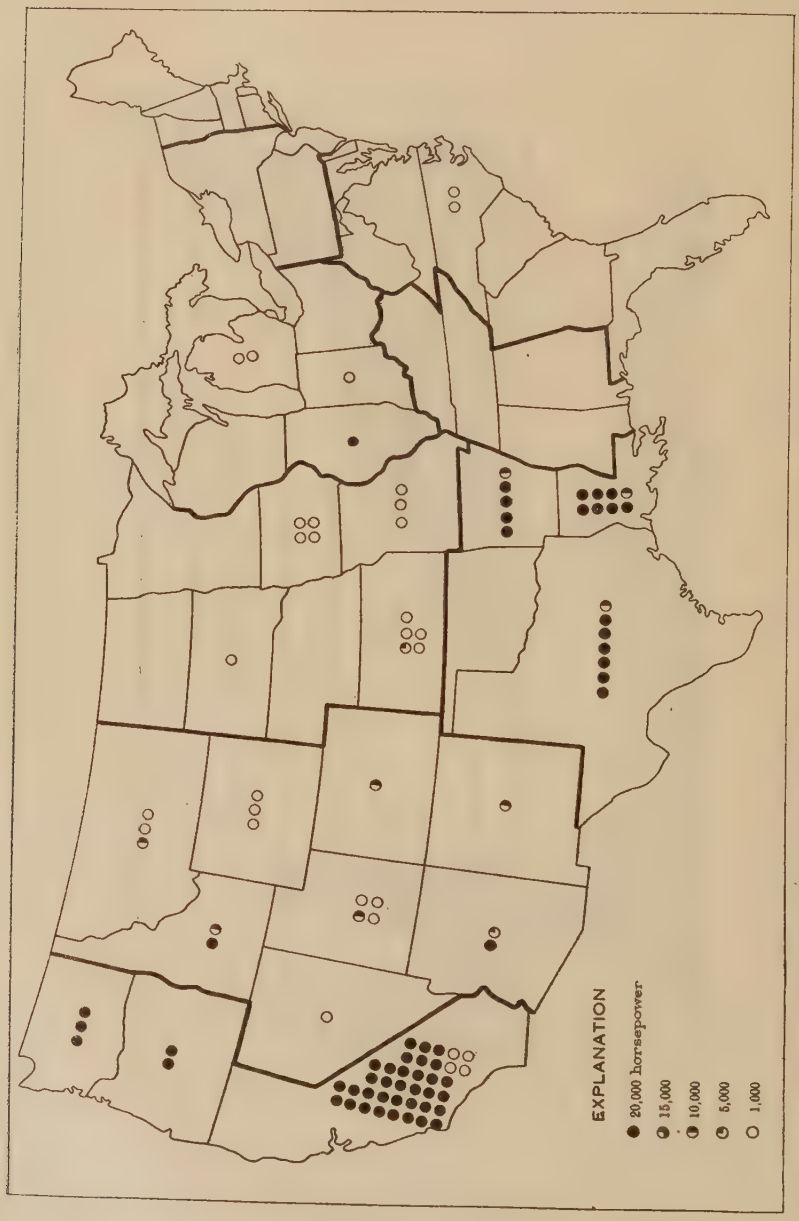



FIGURE 31.—Horsepower of prime movers installed in irrigation and drainage, 1923. (Table 15)

FIGURE 32.—Horsepower of prime movers in central electric stations and electric railroads plus horsepower of electric motors driven by electricity generated in manufactures, 1923, and in mines and quarries, 1919. (Table 18.) Data for mines and quarries for 1923 not available

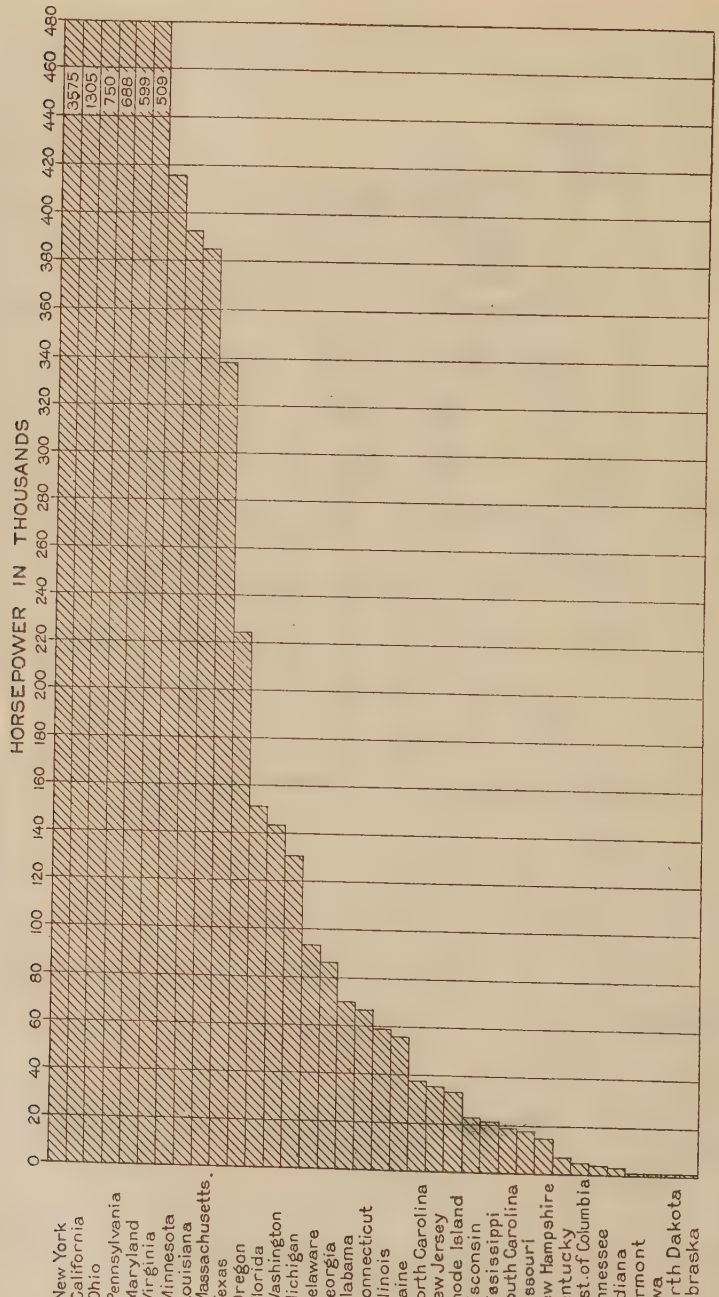



FIGURE 33.—Horsepower of prime movers in ships, 1923. (Table 19)

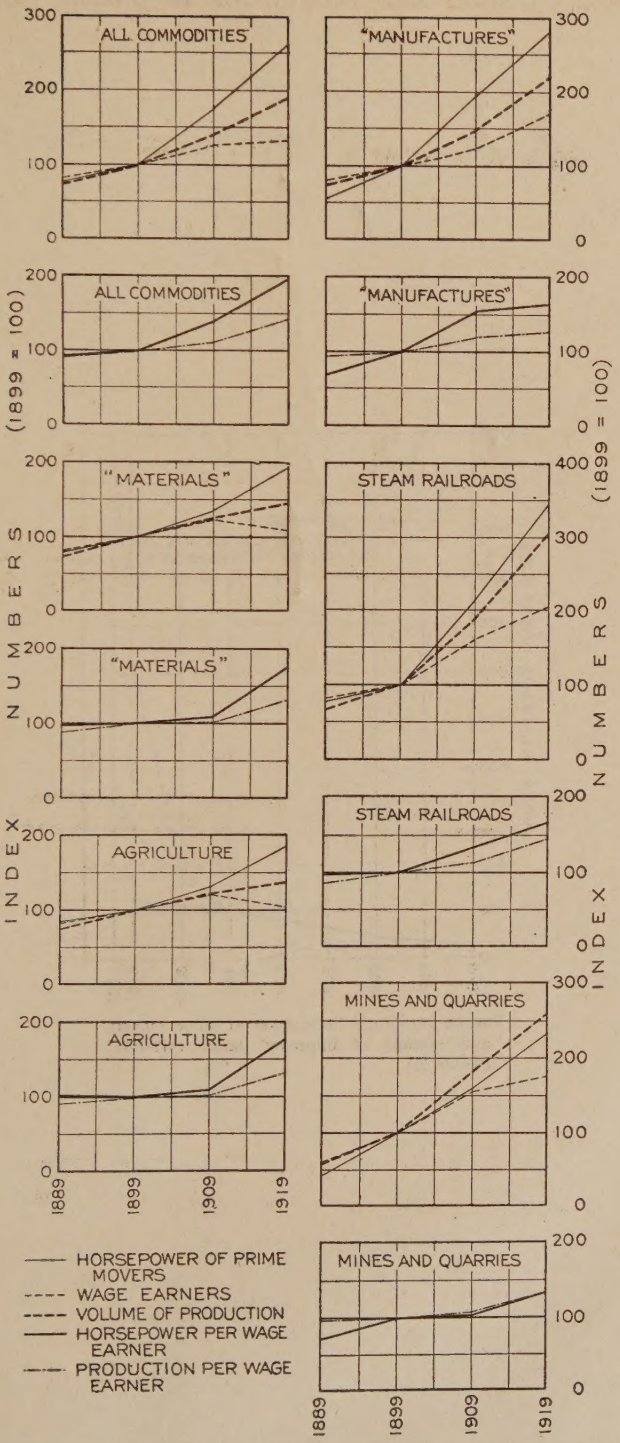



**Figure 34.**—Horsepower of prime movers, number of wage earners, and volume of production, 1889–1919, by special groups. (Table 21)

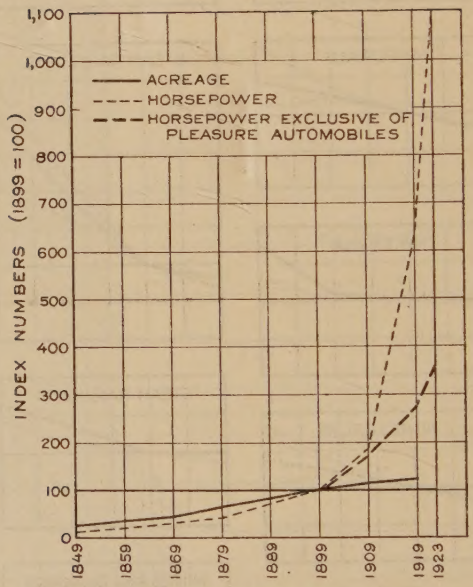



FIGURE 35.—Total horsepower of prime movers and acreage of improved land, 1849–1923. (Table 22)

WESTBROOK PUBLISHING COMPANY
WPCo
PHILA.